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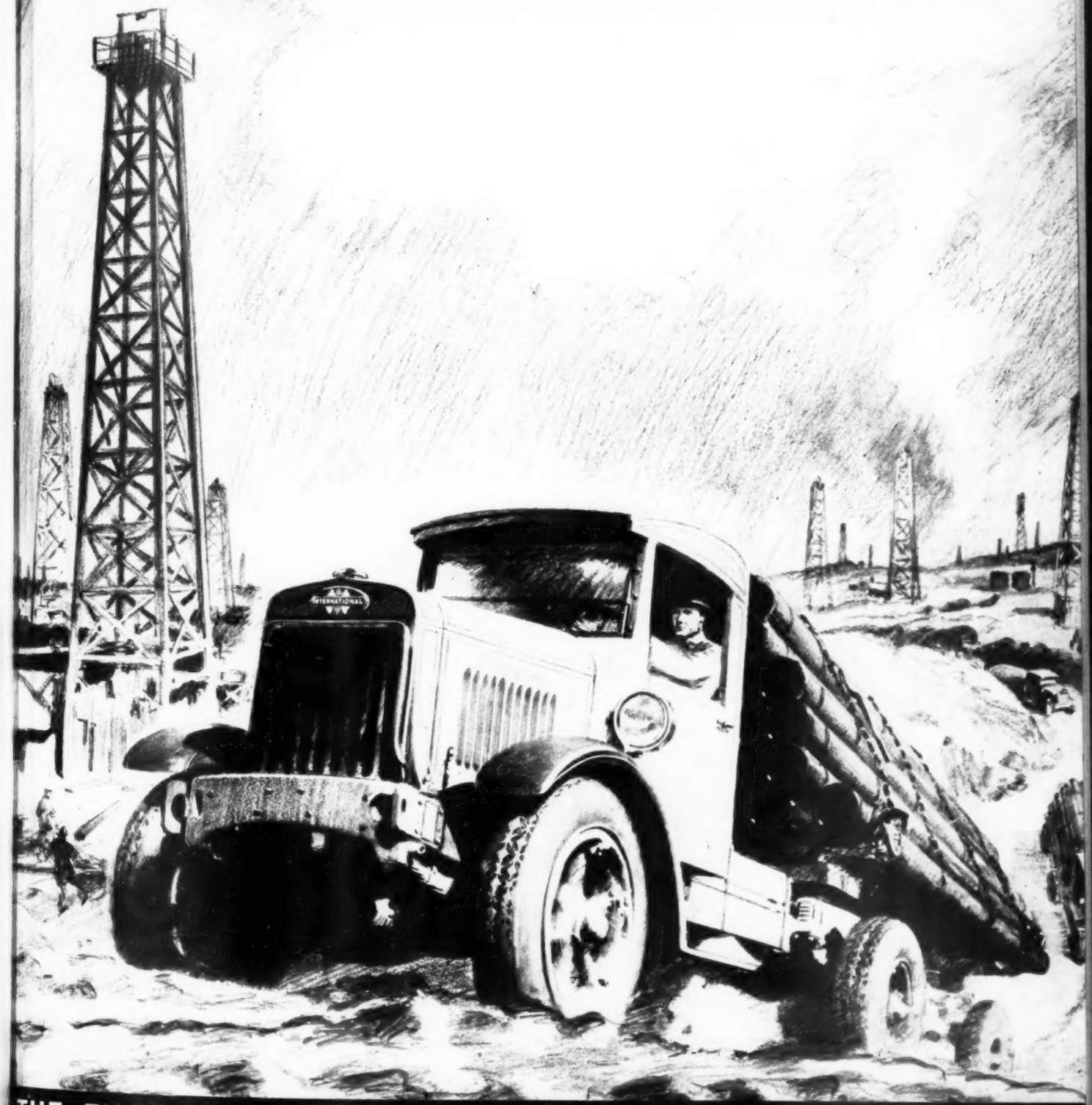
Tulsa, Oklahoma

January, 1932



THE ENGINEERING MAGAZINE OF THE OIL AND GAS INDUSTRY

The men in the picture, left to right, are:

S. B. Smith, contractor; O. G. Wallace, tool pusher; Fred Saxton, truckman; A. P. Iske, driller; R. M. Gyles, derrickman; Pat Bosley, fireman; E. I. Wilcox, derrickman; R. B. Mealy, derrickman; M. J. Bosley, derrickman; Jas. A. Undercofler, Union Wire Rope Corporation.

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The Engineering Magazine of the Oil and Gas Industry

Edited and Circulated Only for those Actively Engaged in the Operating Departments of the Industry

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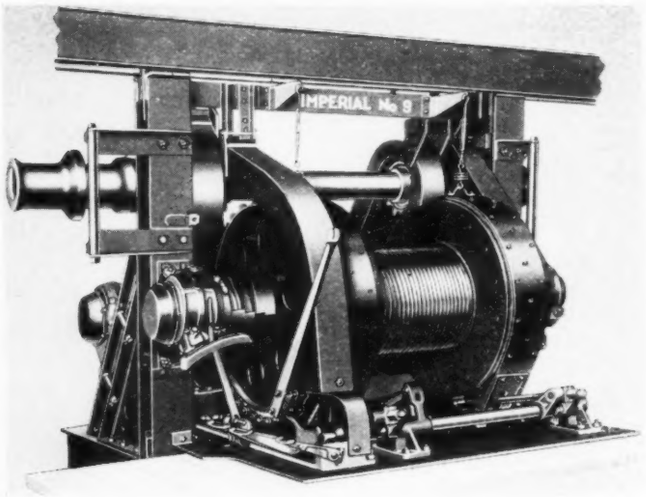

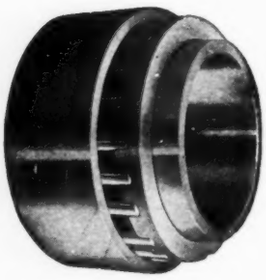

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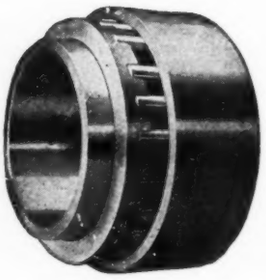

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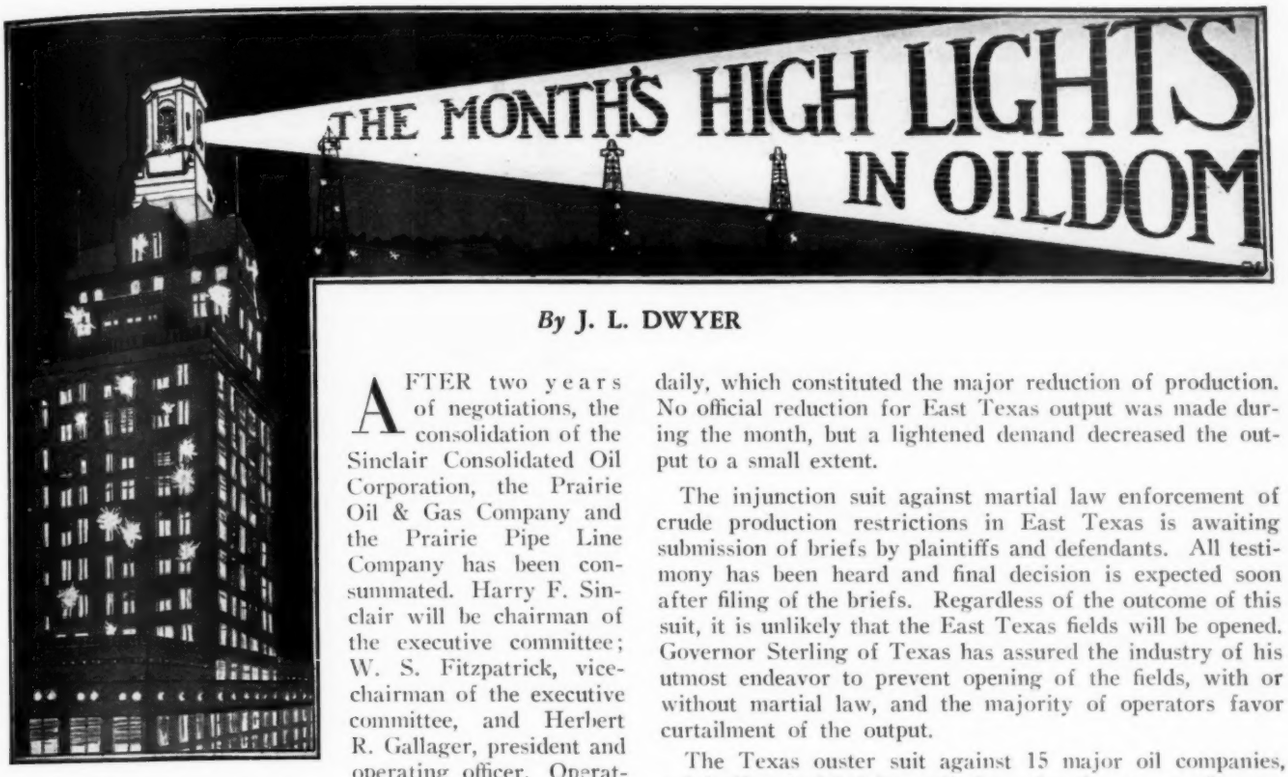


By **J. L. DWYER**

AFTER two years of negotiations, the consolidation of the Sinclair Consolidated Oil Corporation, the Prairie Oil & Gas Company and the Prairie Pipe Line Company has been consummated. Harry F. Sinclair will be chairman of the executive committee; W. S. Fitzpatrick, vice-chairman of the executive committee, and Herbert R. Gallager, president and operating officer. Operating headquarters for the consolidated company will be in Tulsa. The merger forms a company with $532,516,622.88 worth of assets.

A strengthening of the Mid-Continent gasoline market, which the previous month threatened to break crude prices, was the feature price structure development last month. The strengthening of the market was due to further curtailment of crude production and crude runs to stills. Runs to stills at this time are the lowest in the past five years.

Effective January 10th the allowable output of the Oklahoma City field was reduced 40,000 barrels to 120,000 barrels daily, which constituted the major reduction of production. No official reduction for East Texas output was made during the month, but a lightened demand decreased the output to a small extent.

The injunction suit against martial law enforcement of crude production restrictions in East Texas is awaiting submission of briefs by plaintiffs and defendants. All testimony has been heard and final decision is expected soon after filing of the briefs. Regardless of the outcome of this suit, it is unlikely that the East Texas fields will be opened. Governor Sterling of Texas has assured the industry of his utmost endeavor to prevent opening of the fields, with or without martial law, and the majority of operators favor curtailment of the output.

The Texas ouster suit against 15 major oil companies, originally scheduled for preliminary hearing to open January 18th, has been postponed until the February court term. Postponement was due to question of legal service on several companies.

Field developments in Mid-Continent were featured by wildcat activity along Ellsworth-Barton Arch of Kansas, where productive area approximately 70 miles long has been proven by scattered producers. In East Texas a wildcat 3½ miles south of production blew in for an estimated output of 8 million cubic feet of gas. It is now being killed. If oil is found when the well is completed several hundred more acres will be proven.

• • •

Production and Refining Figures Furnished by the American Petroleum Institute

Crude Runs to Stills, Gasoline and Gas and Fuel Oil Stocks, Week Ending December 26, 1931

(Figures in Barrels of 42 Gallons)

DISTRICT	Per Cent Potential Capacity Reporting	Daily Average Crude Runs to Stills	Per Cent Operated of Total Capacity Reporting	Gasoline Stocks	Gas and Fuel Oil Stocks
East Coast	100.0	453,100	71.5	4,480,000	7,912,000
Appalachian	91.8	88,300	64.3	1,330,000	1,601,000
Ind., Ill., Ky.	98.9	288,400	66.8	4,181,000	5,577,000
Okla., Kan., Mo.	89.6	203,200	46.7	3,505,000	4,365,000
Texas	91.3	562,400	73.5	7,573,000	11,873,000
Louisiana-Arkansas	98.9	174,900	75.9	1,262,000	4,070,000
Rocky Mountain	89.4	35,600	24.8	1,665,000	750,000
California	97.1	432,100	48.7	*13,203,000	96,393,000
Total Wk. Dec. 26	95.2	2,238,000	61.1	37,199,000	132,541,000
Total Wk. Dec. 19	95.2	2,317,300	63.2	35,936,000	133,908,000
Total Dec. 27, 1930	95.7	2,207,400	61.8	†37,919,000	136,917,000
The Texas and Louisiana Gulf Coastal figures shown below are included above in the totals of their respective districts.					
Texas Gulf Coast	99.8	447,900	84.3	5,784,000	8,845,000
La. Gulf Coast	100.0	116,700	79.1	1,110,000	3,168,000

Daily Average Production

(Figures in Barrels)

	Dec. 26, 1931	Nov. 28, 1931	Dec. 27, 1930
Oklahoma	534,950	523,850	458,100
Kansas	105,550	104,950	108,800
Panhandle Texas	51,750	56,150	57,250
North Texas	54,350	55,950	58,150
West Central Texas	26,250	26,250	28,900
West Texas	175,600	203,000	239,150
East Central Texas	50,300	56,500	40,550
East Texas	316,000	387,950	.....
Southwest Texas	55,200	58,950	82,100
North Louisiana	27,550	29,150	42,000
Arkansas	33,050	37,500	50,950
Coastal Texas	115,700	127,500	159,900
Coastal Louisiana	29,700	32,150	26,150
Eastern (not including Mich.)	108,250	107,550	100,000
Michigan	16,250	15,150	8,800
Wyoming	37,800	36,450	47,150
Montana	7,800	7,750	6,600
Colorado	4,000	3,800	4,100
New Mexico	43,250	44,150	42,300
California	499,600	505,400	565,800
Total	2,292,900	2,420,100	2,126,750

†Revised in Indiana-Illinois district, due to transfer to "Bulk Terminals" of stocks previously reported as "At Refineries."

NOTE: In all the refining districts indicated except California, figures in this column represent gasoline stocks at refineries. In *California they represent the total inventory of finished gasoline and engine distillate held by reporting companies wherever located within continental United States (stocks at refineries, water terminals and all sales distributing stations, including products in transit thereto).

Water Encroachment Sound Economical

A gas-lift on the Skelly Shepherd lease, Seminole.

WATER encroachment is no longer looked upon as an insidious malady that commonly overtakes oil fields and portends their swift and complete destruction. It used to be that the first showing of water in a highly flush oil pool was construed as a signal for all operators in the pool to bestir themselves to action, but the action taken was not infrequently ill-suited to the exigency. Visions of the sudden shrinkage or the entire wiping out of their investment frequently resolved the action taken into intensive efforts to increase the rate of oil production, a procedure that actually hastened the spread of the very condition that should have been held in check, namely, water encroachment.

The appearance of edge water is gradually losing the ominous aspect once attached to it. It is now regarded as a symptom, and treated accordingly. Edge water coexistent with oil in the sand is a natural occurrence in many oil pools. As the gas and oil are withdrawn from the sand and the rock pressure diminishes, water encroachment is a logical result.

By the virtue of hydrostatic head, edge water generally is a source of energy, the intelligent utilization of which will promote greater ultimate economic recovery and lower lifting costs. Too high a rate of production promotes too rapid water encroachment by creating a low pressure area in the sand around the well. By curtailing the rate of production so that fingering of the water in the sand is prevented, an economic rate of recovery can be sustained over a much longer period than is otherwise possible, and with less trouble and expense.

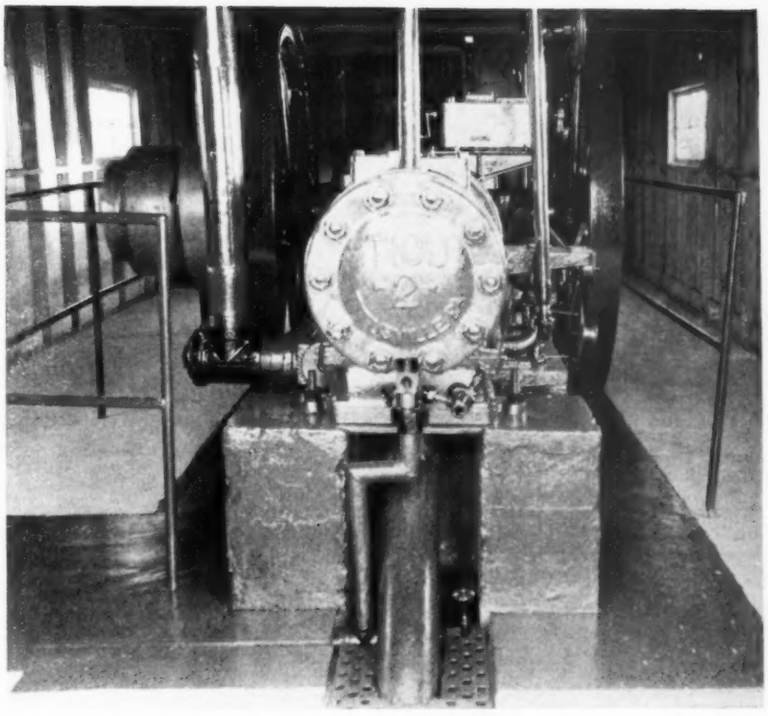
An apt demonstration of the value of controlling water encroachment in this manner is found in the old Earlsboro pool, Seminole County, Oklahoma, on the Skelly Shepherd lease in the SW ¼ of the NW ¼ of Section 6, T 9 N, R 6 E. There are four wells on the lease. Three are on gas-lift and one, Shepherd No. 2, is pumping. The rate of water encroachment in this area has been closely followed by the Skelly Oil Company and an effort made to produce the wells at an optimum rate for the underground water conditions that prevail. The net result is that to date approximately 1,500,000 barrels of oil have been produced on this 40-acre tract, and despite the fact that it has been producing for about three years, its present potential daily rate of production is as great as was its initial production. Like many other leases in the Seminole field, it has been produced entirely under proration. So evident have been the beneficial results on the Shepherd and surrounding leases by curtailing the daily rate of production that this company does not produce its wells to full capacity even during the taking of potentials, for fear of damage by water. The average daily rate of production that has been sustained over a long period with practically no decline has confirmed the wisdom of the course followed. Potentials taken on the wells November, 1931, were approximately as follows: Shepherd, 3,540 barrels; Cherry, 893 barrels and Mayes, 760 barrels. Had the wells been flowed to capacity during the 10-day period allowable it is estimated the potential production on the Shepherd and Cherry leases would have been 4,500 and 1,100 barrels, respectively. Compare these figures with potentials taken in March, 1931, of 3,738 barrels for the Shepherd lease, 857 barrels for the Cherry and 807 for the Mayes lease.

Emulsion tests are made on each well at least every two

A pumping well on the Skelly Maynes lease, Seminole.

Control Practice

By K. C. SCLATER



View in engine house of pumping well on the Skelly Mayes lease, Seminole.

weeks to detect the presence and amount of water being produced with the oil. This information is used to prepare for purposes of field study, a map, as shown on the accompanying illustration, that presents a graphic picture of the rate of water encroachment. The advantage of portraying the rate of water encroachment in this manner is obvious. The lines represent the approximate edge of the water line as of the date shown. All wells beyond which the water line has encroached produce water in some amount, but not necessarily 100 per cent.

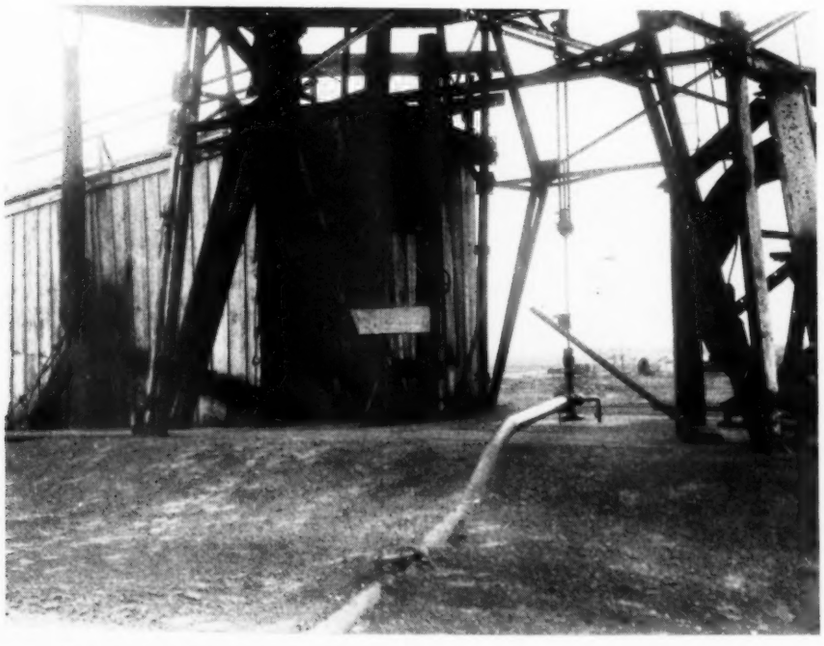
All wells have been on the gas lift at some time since they were brought in, but at present the wells in the area produced by gas-lift are as follows (see map): Skelly Shepherd Nos. 1, 3 and 4; Skelly Cherry No. 4; Prairie-Skelly Campbell Nos. 1, 4 and 6; Carter, James No. 4. Wells produced by pumping are: Skelly Shepherd 2; Skelly Cherry 2a; Skelly Mayes Nos. 1 and 3; Prairie-Skelly Campbell Nos. 2, 3, 5 and 9; Gypsy-Sango Nos. 11 and 13; Burke-Greis Mayes Nos. 1 and 3 (these wells shut down at this writing); and Burke-Greis Widener Nos. 1 and 2. The average depth of the wells is about 4,350 feet, and all are producing from the Wilcox sand, which is approximately 20 feet thick in the area. The wells of the Skelly Oil Company are finished with 6⅝-inch casing and are tubed with 2½-inch upset tubing. Gas is supplied to the gas-lift wells from the Skelly gasoline plant on the Shepherd lease at a plant pressure of approximately 300 pounds per square inch.

As will be seen by the map there are some six wells in this area that have not yet shown a trace of water. Prairie-Skelly well Campbell No. 1 showed water (about 4 per cent) for the first time in November, 1931, during the taking of potentials. Skelly Shepherd well No. 2 started to produce water almost overnight in February, 1931, when it showed 65 per cent. Before then it hadn't shown a trace of water. Skelly Mayes No. 3 was making about 30 per cent water September, 1929, and increased to about 70 per cent September, 1930, since which time it has fluctuated between 65 and 50 per cent.

On the Skelly Cherry lease, well No. 4 has never shown any water, but well 2a was making 10 per cent water September, 1930, and 15 per cent in November, 1931, during the taking of potentials.

On the Prairie-Skelly Campbell lease well No. 3 started making water during 1931. It was making about 15 per cent water during September, 1931, and then jumped to 85 per cent in November, 1931, when potentials were being taken. Well No. 3 has produced consistently about 80 per cent water since September, 1929. Well No. 4 since September, 1929, to November, 1931, has fluctuated from 55 per cent down to 20 per cent and up to 67 per cent. Well No. 5 started producing water during 1930 and since September, 1930, when it was 55 per cent, jumped to 64 per cent in September, 1931, and 48 per cent in November, 1931, during the taking of potentials.

On the Burke-Greis Widener lease wells Nos. 1 and 2 are making water showing in September, 1931, 63 per cent and 10 per cent, respectively. During the taking of potentials November, 1931, the water produced with the oil



View showing casing-head connections of pumping well on the Skelly Mayes lease.

was 56 per cent and ..' per cent, respectively. On the Gypsy-Sango lease wells Nos. 11 and 13 have been making consistent amounts of water since September, 1930, of between 80 and 88 per cent and 5 and 7 per cent, respectively.

Well No. 4 on the Carter James lease was making about 4 per cent September, 1930, and 33 per cent September, 1931, and 48 per cent when the November, 1931, potentials were taken.

On the Burke-Greis Mayes lease well No. 1 showed no water September, 1930, and 100 per cent water September, 1931. The plugging of this well is now under consideration. Well No. 3 had a potential of 700 barrels oil and was not making any water up to May, 1931. Casing trouble developed in the well during May, 1931. An effort was made to repair the well and put it back on its former status, but without success. The well is now producing about 50 barrels oil and some water. From this it is quite possible that the water encroachment may have reached a line joining the wells Burkes-Greis Mayes No. 1 and Skelly Lottie No. 1.

All other wells in this area, save those mentioned, have been plugged on account of water flooding.

Referring to the water encroachment lines on the map near Skelly Shepherd well No. 2 and Skelly Cherry No. 4, the fingering of the water toward the former well was disclosed by the map about two years before water appeared in the well (Skelly Shepherd No. 2). Retardation of water encroachment through producing Skelly Cherry No. 4 at a judicious rate is clearly brought out on the map.

From the water percentage figures already given, Skelly Mayes No. 3 shows a smaller percentage of water and a greater potential oil production than a year ago. Thus are the beneficial effects of retarding water encroachment by controlling the rate of production being felt.

It has been observed that when water appears in a well the oil production drops off to such an extent that it becomes quite serious. A sudden reduction of 50 per cent or more is not uncommon. When water first appeared in the Carter well James No. 4 during the taking of potentials in March, 1931, virtually overnight, the well started making 25 per cent water with a corresponding serious reduction in oil production. In this respect the well acted in a manner somewhat similar to the nearby Skelly well Shepherd No. 2. This well, as already mentioned, started making water for the first time February, 1931, and in the amount of some 65 per cent.

Also when water overtakes a well flowed by gas-lift there is a sudden dropping off in the amount of casinghead gas produced by the well with a corresponding reduction also in the amount of enrichment that the dry gas used to flow the well undergoes. This in itself is a serious source of revenue loss. A full recognition of the consequences of too rapid water encroachment and the fact that the Skelly Shepherd lease was surrounded by water on all sides led in part to curtailing the production from wells even when taking potentials. The probable advantage of taking out the oil at such a rate that the favorable results of a natural water drive could be realized has already passed the realm of conjecture.

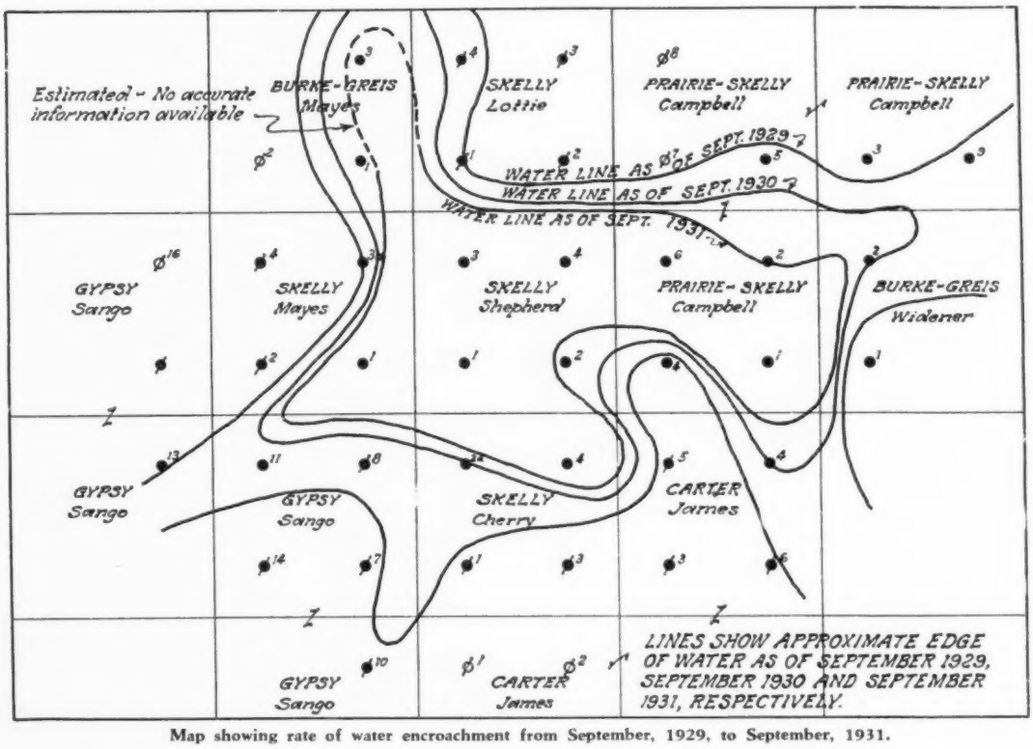
A glance at the accompanying map plainly indicates the effectiveness and inherent soundness of controlling the rate of water encroachment. It is estimated that the ultimate production of the Skelly Shepherd lease may be as much again as the total production of the lease to date. This would mean a total ultimate recovery of approximately 3,000,000 barrels. It is questionable if this lease would have produced anywhere near this quantity of oil had the rate of production not been voluntarily controlled during the taking of potentials.

Lifting costs on the Shepherd lease are exceptionally low to date. For example, here are the lifting costs for the Shepherd, Mayes and Cherry leases, for the first 10 months of 1931, and the cumulative to October, 1931, since the leases started producing:

	First 10 Months of 1931	Cumulative to October, 1931
Shepherd	3.61c/bbl.	14.61c/bbl.
Mayes	6.97c/bbl.	17.52c/bbl.
Cherry	11.40c/bbl.	10.86c/bbl.

On the Shepherd and Mayes leases the lifting costs for the first 10 months of the year 1931 are only a fraction of the total cumulative lifting cost, indicating that the lifting costs are actually on the decrease as the wells grow older. These costs include everything but overhead. Field operating expense, which is one of the main items of the lifting cost, includes labor, tractor, teaming and trucking, fuel and water, conditioning wells, and repairs and supplies.

From a consideration of the results obtained by the Skelly Oil Company in this area, so far as greater ultimate recovery and lower lifting costs are concerned, proration, instead of working a hardship on operators, is in reality a blessing in disguise.

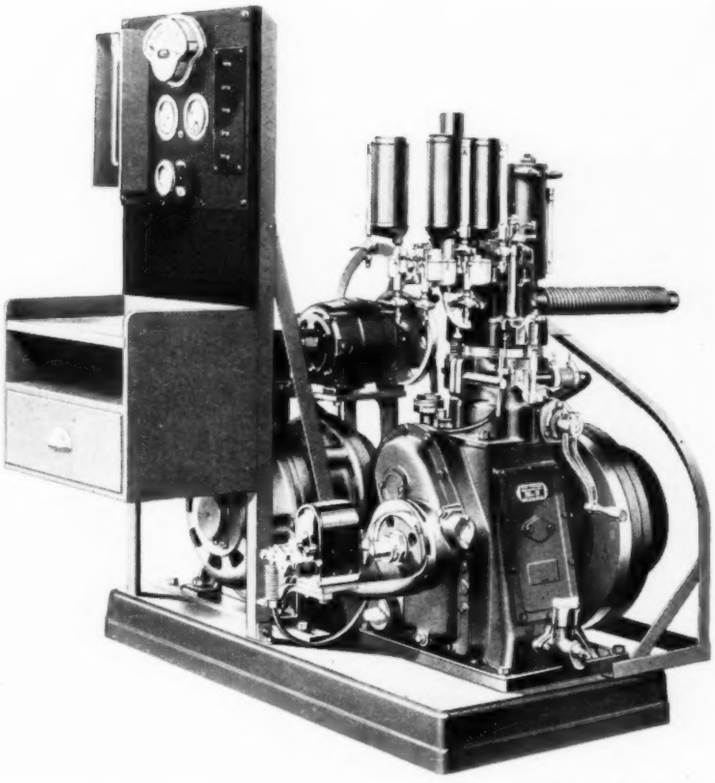


Map showing rate of water encroachment from September, 1929, to September, 1931.

Refining Procedure *and* Method *of* Testing *for* Octane Number

By F. R. STALEY

ONE of the most valuable properties of a motor fuel today is its knock rating, usually expressed as the Octane Number. This scale was suggested in 1926 by Dr. Graham Edgar of the Ethyl Gasoline Corp. It has been adopted by the Society of Automotive Engineers, and is now universally used. The Octane Number of a motor fuel is defined as the percentage of Iso-Octane (2-2-4 trimethyl pentane) by volume in the mixture of Iso-Octane and normal Heptane required to match the anti-knock value thereof. Of these two pure hydrocarbons the normal heptane has a very low knock rating, and that of the iso-octane very high.



Courtesy Waukesha Motor Co.

The CFR fuel testing unit.

Great progress has been made by the refining industry in the production of suitable motor fuel for high compression engines. Most refiners in the United States are now licensed to blend ethyl gasoline. By the use of ethyl fluid the octane number is raised to meet the ethyl standard. This will be raised from 74 to 78 on March first.

Since some gasolines would require more than the maximum allowable quantity of ethyl fluid to match the standard, and also in order to produce satisfactory non-premium grades refining methods are being adopted that yield motor fuels possessing inherent anti-knock qualities. Owing to the fact that cracked gasoline is generally superior in this respect to the straight-run product from most crudes, a great many new cracking plant installations were made during the past year, and others are being constructed and contemplated at the present time. In some refineries existing units were modernized usually by improving furnaces, installing more efficient hot oil pumps, heat exchangers, or other auxiliary equipment.

It is noteworthy that a number of modern cracking units were built in Pennsylvania and West Virginia last year by refiners of Pennsylvania grade crude. On account of the very low octane number of this gasoline it is necessary to blend it with one of high octane, which these refiners now make from their cracking units. It is possible to produce octane numbers above 70 by cracking Pennsylvania gas oil.

Heavy naphtha or those fractions having very low octane numbers are no longer blended into good grades of motor fuel. The modern procedure is to reform these hydrocarbons by pyrolosis in a cracking unit or in a special reforming unit, a number of which have been built recently. Their function is to increase the octane number of the charge. The straight-run gasoline from the crude is generally fractionated with an end point below 400 deg. F. and blended with cracked gasoline.

Stabilization units are now almost universally installed in connection with cracking plants to remove propane and dissolved gas from the gasoline. By their use the vapor pressure of the product can be nicely controlled, and the vapor locking tendency minimized.

Much study has been given to the treating of cracked gasoline for the removal of objectional sulphur compounds, gums, and gum forming constituents. The Gray Process for the treatment of gasoline in the vapor phase is gradually being more widely adopted, since Gum removal is effected without diminishing the octane number.

The results of the U. S. Bureau of Mines twenty-third semi-annual survey of motor fuel marketed in the United States show that the average rating for the competitive-price samples is 62.5 octane number, and the average for the premium price samples is 77.0 octane number. The average for all the samples is approximately 67 octane number, and less than 18 per cent of the samples were rated below 55 or above 79 octane number. Of the competitive-price samples 72.5 per cent are in range 55 to 69 octane number, and of the premium-price motor fuels 76.2 per cent are in the range 70 to 84 octane number, and 13.3 per cent are in the range of 85 to 89 octane number.

The twenty-third semi-annual gasoline survey of the Bureau of Mines was made on the basis of 312 samples; 207 samples of the competitive-price gasolines and 105 samples of premium-price motor fuels. These samples were

gathered in 20 representative cities scattered throughout the United States.

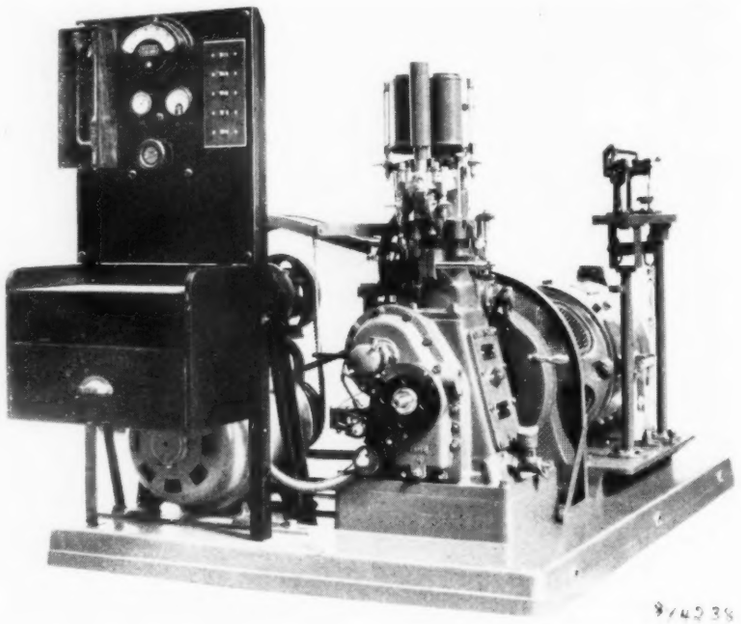
Data on the individual samples have been reported for gravity, Reid vapor pressure, distillation range, color, doctor test, copper-strip corrosion, sulphur content, and gum content by a modified copper dish test, and the steam-oven test developed by the Bureau of Mines. The octane number ratings were determined by the Bureau of Standards.

Method for Knock Testing

The Ethyl Gasoline Corporation Series 30 Knock Testing Engine is most widely used in this country in conducting tests for knock rating or determining the octane number of a motor fuel. Bartholmew described this apparatus in the Petroleum Engineer, March, 1930.

T. A. Boyd, General Motors Corporation, chairman of the Detonation Sub-Committee of the Co-operative Fuel Research Committee presented a report of the progress made toward uniformity in knock testing at the American Petroleum Institute Meeting, November 11, 1931. This report outlines the progress as follows:

1. Further improvement of the engine, and settlement upon the continuously variable-compression valve-in-head type as the best to use for knock testing. 2. Design and manufacture of a carburetor expressly for the knock-testing engine. 3. Choice of an induction motor which runs at synchronous speed and holds the engine at 600 r.p.m., as the power-absorbing medium. 4. Tentative choice of the bouncing-pin indicator as instrumentation, in conjunction either with the electrolytic cell or the knockmeter. 5. Preparation of a tentative outline of procedure for making knock tests. 6. Provision of adequate supplies of the reference fuels, normal heptane, and iso-octane (2-2-4 trimethyl pentane), which constitute the basis of the octane-number system of rating fuels. 7. An organized series of experiments to evaluate the most important of the variables that enter into knock testing. 8. Co-operative tests on a series of fuels, which showed that the apparatus and procedure as now developed are capable of giving accurate results, and results which consequently agree from laboratory to laboratory. 9. Approval by the Co-operative Fuel Research Committee of the apparatus and the tentative procedure for its use. 10. Making the apparatus and tentative outline of procedure available to the two industries concerned.



Courtesy Waukesha Motor Co.

Standard CFR unit with a small cradle dynamometer.

Appendix I of this report describes the "C.F.R." Knock-testing Apparatus. The "C.F.R." knock-testing apparatus consists of the following essential parts:

1. Engine, which is fitted with these primary accessories:
   a. Carburetor.
   b. Ignition equipment.
   c. Cooling system.
2. Power-absorbing medium.
3. Small direct-current generator.
4. Instrumentation.
5. Control panel.

Appendix II outlines the tentative recommended practice for making knock tests.

Standard Reference Fuels

Pure normal heptane is distilled out of the pitch of the Jeffrey pine. Iso-octane is prepared in the pure state from butyl-alcohol. Due to the high cost of these pure hydrocarbons secondary reference standards are used for routine testing.

Standard reference fuels for use in conducting knock rating tests are obtainable from the Standard Oil Development Company. Standard reference fuels A and B are straight run gasolines with physical characteristics suitable for long time storage.

These reference fuels with additions of Tetra-Ethyl lead or C. P. Benzene have been calibrated in the Standard Inspection Laboratories in terms of Octane Numbers on Ethyl Gasoline Corporation Series 30 Knock Testing engines. Fuel comparisons were made with the bouncing pin. The data were obtained with very definite operating conditions and technique at two temperatures of the cylinder cooling medium, 212 degrees F. and 300 degrees F. It is becoming common practice to rate Aviation fuels at a higher cooling medium temperature than Automotive fuels. The Octane Number calibration curves so obtained are not identical at the two temperatures and to distinguish one from the other, the rating obtained should be referred to as Octane Number at 212 degrees F. or Octane Number at 300 degrees F.

The CFR Fuel Testing Unit is shown in one of the photographs with the four bowl special carburetor, all set up complete with belt guards and standard ball bearing back absorption motor.

Another form of this unit has been used successfully by the Army at their various airports which combines the standard CFR unit with a small cradle dynamometer. With this combination a complete range of tests can be performed, and the whole thermo-dynamic analysis, both of the engine and the fuel can be made.

References

1. Bartholmew; Petroleum Engineer, March, 1930, Series 30 Knock Testing Apparatus.
2. U. S. Bureau of Mines Reports of Investigations, 3129, 3142, and 3152.
3. T. A. Boyd, The Co-operative Fuel Research Apparatus and Method for Knock Testing, Twelfth Annual Meeting, A. P. I.
4. Instructions for using Standard Reference Fuels, Standard Inspection Laboratories, Standard Oil Development Company.

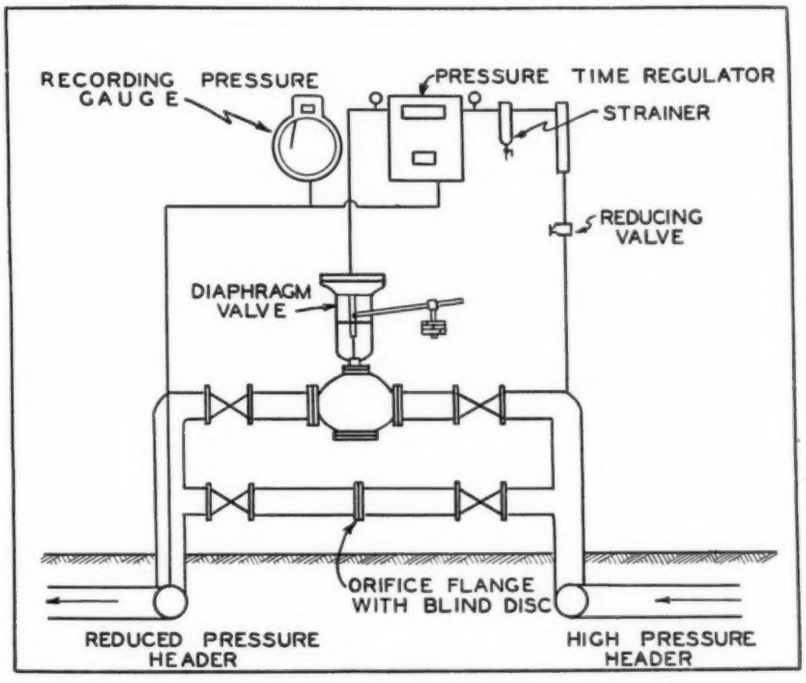
Controlling Border Station Pressures Automatically

By J. H. DAMERON

IN THE delivery of natural gas the control of pressures at the border stations frequently entails considerable trouble and sometimes excessive expense because of the load variations during a 24-hour period. During the several stages of pressure reduction from the main line carrying 300 pounds or more the steps are easily accomplished by the regulators. Most of the trouble encountered by the transmission company is in maintaining the proper pressure in the intermediate line running from the border station to the city distribution system, perhaps several miles distant.

Many distribution systems are designed so the intermediate line belts the city with low pressure regulators set at the various branches. The pressure is reduced to ounces at these points. In other systems the intermediate pressure is carried in all the distribution lines and low pressure regulators at each meter setting brings about the final reduction in pressure.

It frequently happens that during peak periods the pressure in the intermediate lines are too low to adequately care for the requirements at that time. Especially is this true during the winter months.



Piping diagram for automatic regulating installation.

To overcome this condition either higher pressures must be maintained constantly in the intermediate lines from the border station or the pressure must be raised and lowered periodically to meet the load variations. In the first instance considerable more pressure would be carried in the lines than actually needed for more than half of the 24-hour period. This would of course increase the possibility of blowouts and leakage. Stationing a man at the town border station to change the regulator settings to meet the variable conditions would increase delivery costs as would the method of having a crew make "flying" visits to various border stations.

Manual operation of the border stations give a more or less step control in the changing of pressures with the accompaniment of pulsations or surges in the flow lines. The factor of control is particularly important, both from the standpoint of adequate pressures in the intermediate lines as well as smoothness in pressure changes for measurement purposes. Smoothness of flow is a great factor in accurate measurement of flow by orifice meters. Uneven changes in pressure may cause pulsating or surging effects which is evidenced by a widely inked differential on the orifice meter chart or mercury blown from the meter reservoirs.

To meet such conditions the Oklahoma Natural Gas Corporation installed a pressure-time regulator to automatically control the changes in pressures in its intermediate line in accordance with the predetermined schedule, at its Shawnee, Okla., border station. The installation has been in service more than a year and has given satisfactory service.

The instrument operates in connection with the intermediate line regulators, raising and lowering the pressures in those lines as required. It functions with a cam operated by a clock by changing the setting point on the regulators automatically to meet the peak and low demands.

At Shawnee the installation is located adjacent to the main line several miles distant from the city. Main line pressure, which ranges from 200 to 300 pounds, is dropped down to 150 pounds by the high pressure regulation equipment. This setting is operated in connection with a heater which heats the gas before its pressure is reduced.

The gas goes from the high pressure regulator to the header in the border station at about 150 pounds. It is reduced again to 26 or higher pressure by the pressure-time installation for delivery into the intermediate lines.

The pressure-time regulator requires 25 pounds pressure for operation. It is connected to the regulator setting with quarter-inch lines. One line is connected to the high pressure side of the regulator valves and a reducing valve drops this pressure down to 25 pounds. A reservoir is located on this line leading to the instrument and acts as an air cushion. A strainer is also located on the line to remove particles of dust which might find their way to the parts of the pressure-time regulator.

In the operation of the regulator the pressure under control works against a capsular diaphragm element which in turn contacts with the pilot valve. Under an increase or

decrease in line pressure the expansion or contraction of the diaphragm regulates the admission of the installation actuating pressure to operate the lever weighted valve.

The pilot valve in the installation is mounted on a carrier arm which in turn contacts with the cam. The movement of the cam raises or lowers the position of the pilot valve with reference to the capsular diaphragm element and thereby gives a pressure increase or decrease in relation to the time setting on the cam.

The cam is operated by a clock, in this instance a 24-hour clock. This is wound daily when the chart changer makes his visits to the station to change charts.

The installation is mounted on an instrument board attached to the wall of the sheet metal building. On the same board are recording pressure gauges, one of which records the transmission line pressure and the other records the pressure in the border station header. Pressure in the intermediate line is recorded on the orifice meter charts.

To protect the instrument's mechanism a lock is provided for the glass front door which is the full size of the metal case. The clock may be wound without opening the door by inserting the key through a port made in the door. The small glass front permits the chart changer to observe if the clock is running and the cam is operating.

No additional equipment except a small amount of quarter-inch pipe and the instrument itself, is required for installation. Nor do any changes have to be made in the layout of conventional spring type or lever type regulator stations. The connections to the existing piping and regulators may be accomplished easily and quickly.

The Shawnee border station uses a double regulator setting. One is a 6-inch setting and the other a 4-inch setting. The larger is used during the winter months when the load is heavy and the smaller setting during the summer months. Both settings are tied into the pressure-time regulator. Either one or both may be cut off by closing necessary valves on the quarter-inch lines. This permits ready change over to either regulator or complete cutting out of the pressure-time regulator. The pilot operated time-pressure regulator is highly sensitive in its action and flexible in its range of adjustment. Its high degree of sensitivity makes for a smoothness of pressure regulation regardless of fluctuations in loads. It permits the transmission company to carry higher pressure during the morning, lower them during midday, raise them again at night and lower them later on and do so automatically.

The cams, which control the changes in pressure, may be cut for any changes in pressure required and so cut that the change may be gradual over a period of 30 to 60 minutes or more rapidly.

Cams are usually cut after an observation of charts covering corresponding periods.

Originally four daily changes in intermediate line pressure were desired each 24-hour period at the Shawnee station. A blank cam was cut for the changing and maintaining of the pressures in accordance with a predetermined schedule. The schedule follows:

Increase pressure over a 30-minute period from 6:00 A. M. to 6:30 A. M. from 26 pounds to 33 pounds.

Hold at 33 pounds from 6:30 A. M. to 9:45 A. M.

Drop pressure over a 30-minute period from 9:45 A. M. to 10:15 A. M. from 33 pounds to 26 pounds.

Hold at 26 pounds from 10:15 A. M. to 5:15 P. M

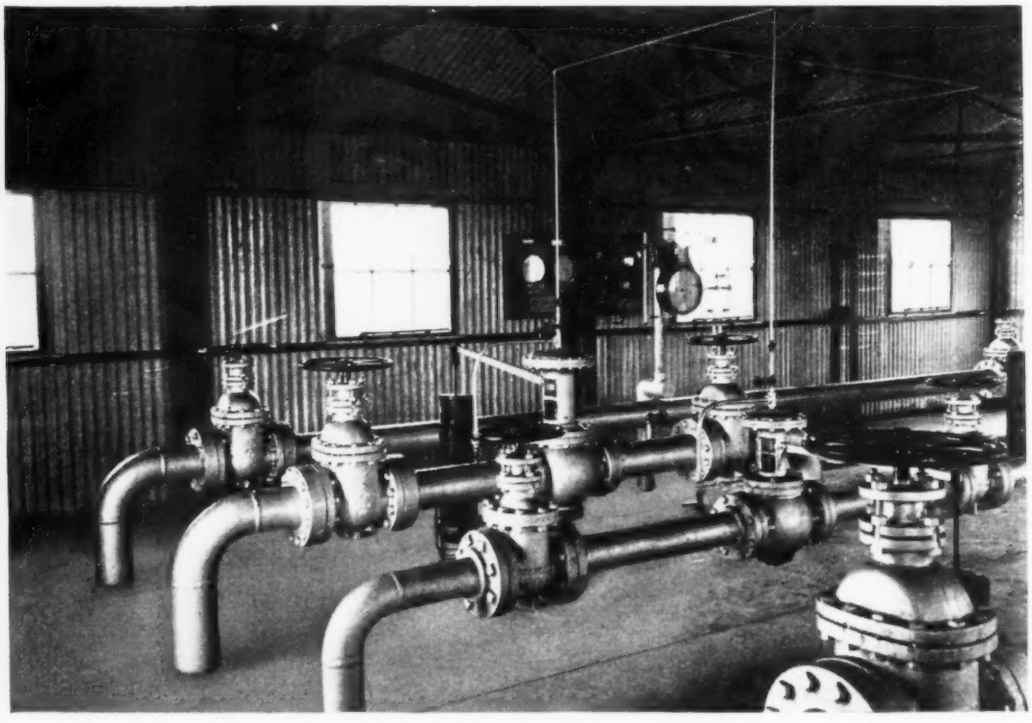
Increase pressure over a 15-minute period from 5:15 P. M. to 5:30 P. M. from 26 pounds to 30 pounds.

Hold at 30 pounds from 5:30 P. M. to 7:55 P. M.

Drop pressure over a 20-minute period from 7.55 P. M. to 8:15 P. M. from 30 pounds to 26 pounds.

Hold at 26 pounds from 8:15 P. M. to 6:00 A. M.

By using the pressure-time installation the transporting company obtains pressure control at the border station automatically. In addition to this feature the installation brings about the necessary pressure changes over short or extended periods without pulsations or surges in the line or disturbance in flow measurement.

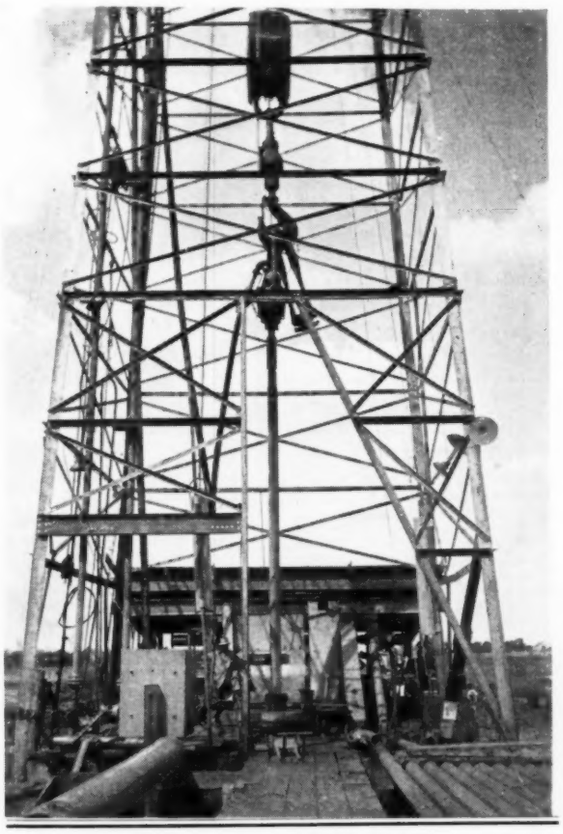


Interior view of Oklahoma Natural Gas Corporation's Shawnee Border Station.

Deep Tests Feature Past Year's Drilling Records

By WARREN L. BAKER

OUTSTANDING among many remarkable drilling achievements of the past year, which included the running of the longest casing string, establishment of a new fast cementing record, and a new rapid drilling mark, was the feat of exploring to depths below 10,000 feet by three tests in different parts of the world. These accomplishments, together with the annually increasing number of wells drilled to 8,000 and 9,000 feet, definitely show the deeper trend of drilling and the ability of present-day modern equipment, without special reconstruction, to bore at depths of two miles. The deepest test in the world is the Penn Mex Fuel Company's No. 35 Jardin, near Alamo, Vera Cruz, Mexico, where an 8 5/16-inch hole was carried to a depth of 10,585 feet. This well has made very interesting drilling history, not only because it is 500 feet deeper than any other test, but because many obstacles were encountered that enormously increased the difficulty of drilling.[1]



Heavy duty rig in Oklahoma City area.

Jardin No. 35 became a hot salt water geyser soon after drilling was begun and continued to produce salt water with a temperature of 162 degrees F. during the entire drilling procedure. At one time the flow was 300,000 barrels daily, and in addition several noxious gas-carrying horizons were penetrated. Despite these obstacles, drilling operations were unusually successful, largely because of modern deep well drilling technique and field engineering.

It is interesting that in the latter part of drilling operations on this record test, the flow of salt water was actually put to work by using it as circulation fluid. A series of by-passes placed enough back-pressure against the flow so that pump pressures were sufficient to reverse the circulation, flowing the salt water up through the drill pipe, to be used as circulation fluid.

Honors for being the second deepest hole in the world go to the Mid-Kansas Oil & Gas Company and Ramsey Petroleum Corporation's Preston-Culp No. 6 well, near Cement, Okla., which was bored to a depth of 10,079½ feet. The well reached this depth, before trouble was encountered, with the use of regulation heavy-duty rotary equipment, which must be considered a tribute to mechanical drilling devices now in use.[2] The first well to reach 10,000 feet was near Ventura, Calif., where the Chanslor-Canfield-Midway Oil Company drilled its Hobson No. AO2 to 10,054 feet, arriving at that depth about the middle of the year 1931. Electricity was used throughout in drilling this test, which was done with standard rotary type equipment generally used in California for deep drilling.[3]

While none of the three 10,000-foot tests has found commercial production at this great depth, sufficient encouragement in the way of promising showings and formations of geological importance were encountered to make it unlikely that the quest for crude oil producing horizons beneath present-day deep stratas will be abandoned. Showings of sufficient quality were found at 10,000 feet in two of the wells to cause the crew to make a production test, but in both cases the wells were plugged back to upper horizons.

Early oil wells were shallow and the loads on equipment were correspondingly light. As drilling extended into deeper territory it became evident that the machinery could not withstand the severe punishment, consequently it has been imperative that manufacturers be ever searching for new methods and new materials to meet the increased demand. The tremendous strides made by engineers of manufacturing companies in perfecting and improving drilling devices, and a better understanding of field problems and engineering have been most important factors in deeper drilling.

Tests of 12,000 feet can be foreseen with present-day equipment, and doubtlessly the future will witness equipment improvements that will permit even deeper drilling.

The establishment of a new record for long casing strings was another important development of the year, one that demonstrated the possibility of setting even longer strings. The outstanding feature of running 9,777 feet of 6⅝-inch pipe, weighing 130 tons, at the Mid-Kansas and Ramsey well was the remarkable ease of placing the pipe in the hole with the use of the floating-in method, while the most important result was failure to obtain mud circulation afterward, probably due to the small annular space between the

[1] Drilling World's Deepest Hole, by Warren L. Baker, The Petroleum Engineer, October, 1931.

[2] Drilling the Deepest Hole East of California, by Warren L. Baker, The Petroleum Engineer, September, 1931.

[3] The First Ten Thousand-Foot Hole, by W. A. Sawdon, The Petroleum Engineer, August, 1931.

casing and the hole side walls and to the compression of the mud.[4]

Another factor indicating the possibility of setting longer casing strings was the quickening of cementing time, as naturally a greater period of time is required to place cement behind a longer casing string. Bottom hole temperatures in some of the deep tests have been quite high, which has had the effect of accelerating the setting of cement.

Cement operations were so speeded up that in one instance a string of 9⅝-inch casing was cemented at 5,500 feet in the record time of 34 minutes, including the mixing and getting of the cement to the bottom of the hole.

Where exceedingly high temperatures have been found, such as in the Greasewood (Colo.) field and at the Mid-Kansas and Ramsey test, ice has been adopted as a means of cooling the bottom of the hole and has somewhat offset the effect of high temperatures on the cement. Between 14 and 20 tons of ice is dumped into the mud pits, and this cooled fluid is used for circulation before cementing.

A new world's drilling footage mark for a 24-hour run was made by the Olson Drilling Company last year, when one of its crews made 2,393 feet on a Colorado test. Such unusually rapid time, of course, is not the ordinary occurrence and depends not only on equipment but to a great degree upon the character of formations being penetrated. Some fast drilling time has also been made in the East Texas fields, where it is not uncommon to drill to 3,600 feet in four to five days.

Equipment

A most important equipment development of the year has been the increasing use of higher derricks, which permits the handling of an additional joint of drill pipe to each stand—a most economical factor in deeper drilling.

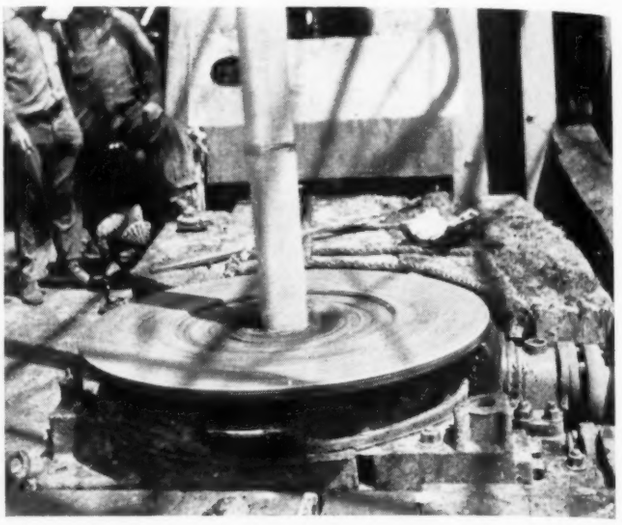
Derricks of 136-foot, 156-foot and 170-foot heights, with 30-foot bases, are now offered by derrick manufacturers. In California a 178-foot derrick with a 32-foot base is in use. This height does not include the gin pole, which is 194 feet above the ground.[5] These derricks now range up to 1,000,000 pounds dead load capacity—capable of handling the longest string of drill pipe used to date and with a good safety factor.

[4] World's Longest Casing String, by Warren L. Baker, The Petroleum Engineer, November, 1931.

[5] The World's Tallest Derrick Erected in Ventura Avenue Field, Calif., by W. A. Sawdon, The Petroleum Engineer, December, 1931.

Field installation of high pressure boilers.

The longer strings of drill pipe and casing have tremendously increased the loads on traveling and crown blocks, as well as on drawworks. Roller-bearing, two-deck crown block and a mate traveling block, with sufficient manganese steel sheaves to provide 12 lines, are used on deep tests. Wire lines for these are usually 1⅛-inch diameter ones, and a few manufacturers have introduced 1¼-inch diameter lines.



Large, modern rotary table.

Drawworks now have a jack shaft as well as the usual drum with shaft and line-shaft. Modern drawworks have three and four speeds, which, together with increased heights in derricks, have been constructive steps toward preventing the slowing up of hoisting speeds to a point beyond economical reason.

Power plants for drilling are now usually of 125 horsepower, 360 pounds steam pressure boilers, so connected up that one boiler may be used while the others are cut out, or the steam from all of the boilers can be used jointly.

Twelve by twelve twin roller-bearing steam engines are used with such type boilers. Other prime movers, the Diesel, gas engine and electric motors, have also been greatly improved and will probably be more common for drilling purposes in future years.

Requirements for maintaining circulation in deep wells have been responsible for more powerful slush pumps, many of which are capable of building up 1,500 pounds pressure. Steel rotary hose is used in conjunction with these large, powerful mud pumps.

Rotary tables with a 25½- or 27-inch opening, to accommodate large size bits and pipe, are frequently to be found in use. These are built entirely throughout for heavy-duty field work. Some rotary tables have two-speed attachments, whereby the speed of the table may be reduced from above normal and give greater lifting power.

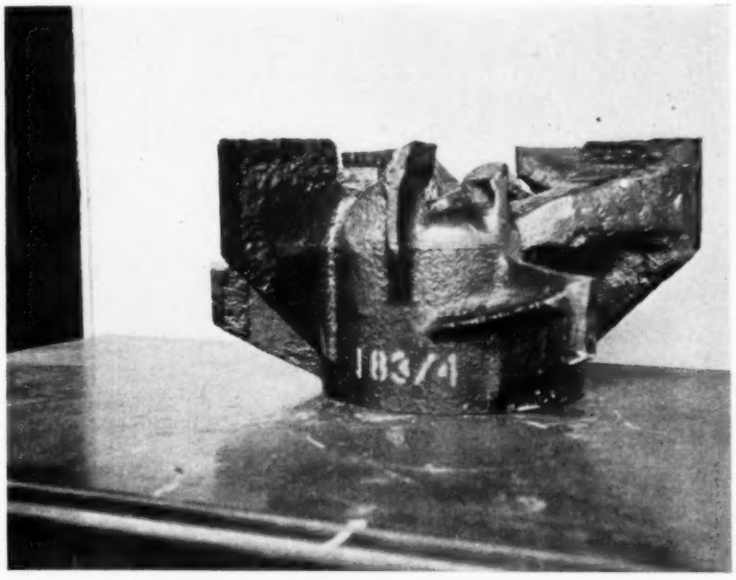
Drill pipe tensile strength has been increased to 100,000 pounds minimum with a reasonable safety factor, and at the same time it is being made in 30-foot lengths as compared to former 20-foot joints. It is now usually pulled in three 30-foot joints and, in the higher derricks, in four joints to the stand.

The next five years will undoubtedly see as great improvements in equipment as last five, and also a number of entirely new-principle drilling devices may be expected. Ten-thousand-foot wells will then have become less and less a rare occurrence.

Hard Faced Bits Factors *in* Drilling Deep Wells *in* California

By W. A. SAWDON, *Petroleum Engineer, Los Angeles*

THE formations encountered in different oil fields, in different sections of the country and in different countries throughout the world will naturally influence the type of bit that should be used to produce the most effective drilling. Fishtails, rock bits, discs and the many types of special bits that have been developed for specific or general application are each most adaptable to meet certain conditions. There are few kinds, however, that cannot be improved by the addition of a hard metal to the cutting edge. Bit manufacturers have recognized this and most of them now sell bits that are hard-faced with either their own metals or metals made by others. California has probably offered the greatest opportunity for developing these alloy metals; but the metals themselves have been an influencing factor in the economical development of the deeper producing areas of California.



This core bit is well protected with a hard facing alloy.

The attention to keeping the bit to gauge is clearly indicated on these special types of bits.

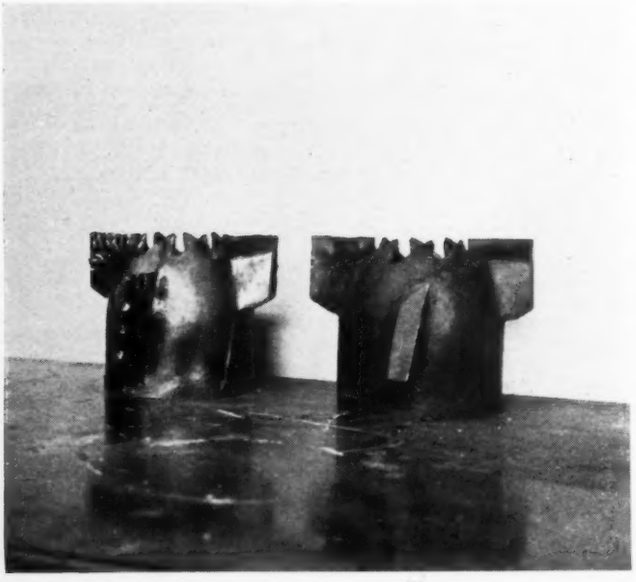
While the application of a "diamond-hard" alloy to many types of drilling and core bits is generally conceded to be most economical, opinion varies as to whether the metal should be used as an insert, in granular form, as a powder or as a combination of these. The first hard facing material was merely a high carbon steel which, although it added considerable abrasion - resisting qualities to the bit, fell far short of having the hardness of a diamond. The insert was then developed and was probably modeled in form from the black diamonds that have been used for many years in diamond core drilling. These inserts took the name of "diamond substitutes" since they have a hardness nearly as great as that of the diamond itself and are used in a way similar to that of the black diamond. This soon led to the manufacture of the granular form which actually consists of inserts of much smaller size, but which offer the opportunity to provide a more even cutting edge of very hard metal with almost no soft space separating the hard particles. The true powdered forms now being made really differ in composition from the inserts and the granular alloys, but like them, are claimed to have a hardness when applied to the bit that closely approaches that of the diamond.

Most of the metals which provide a diamond hardness to the cutting edge of a bit are tungsten carbides or other tungsten alloys manufactured under patented processes. Considerable research work has been done to develop them and to make them adaptable to the duty they must perform. Hardness itself is not sufficient since an extremely hard metal may be brittle and crack or chip when used as a cutting medium. Toughness and strength, therefore, had to be combined with hardness and the resulting alloy has been made to withstand the

severe service to which it is subjected when employed in grinding, cutting and crushing its way through a hard underground formation. The ultimate aim is, of course, to have it resist abrasion to the greatest degree possible so that it will cut for a long period and through a great distance without having to be replaced. Through its ability to do this, the hard metals now being used on drilling bits in California have done their share in keeping down drilling costs in the deep wells there drilled in the past few years.

No matter how well an article will perform, no matter how much convenience it may provide, if it cannot show an economy in operation it will never acquire a permanent place in industry. The application of hard metal to drilling or core bits entails an added cost to each bit. To offset this, however, it increases the life of the bit to a considerable extent and this item alone would probably warrant its general use. In addition to this, the use of a hard facing material—especially that of a diamond-hard alloy—will enable the bit to drill a much greater depth before being dressed. It is claimed by some that a hard-faced bit will drill three times as much as an ordinary tempered bit and that one faced with diamond-hard metal will drill three times as much as one using a ferric hard facing material. Actually, as much as we all like to have definite comparisons to study, there is no possible way of estimating just how much more one kind of bit will do than another since comparative runs are never identical. Moreover, different formations will have different effects on the cutting edge and will spoil any direct ratios established under different conditions. There has never been an instance reported where the hard-faced bit has not exceeded the performance of a shop-tempered and dressed bit and examples have been cited where the performance of a bit faced with a diamond-hard metal has seemed almost impossible.

The general acceptance of the diamond-hard metal as a cutting edge for bits is well emphasized by the numbers of tests being made by bit manufacturers with different kinds of alloys on the same types of bits. Some of these manufacturers have standardized on one kind of metal while others provide whatever is specified by the purchaser. An example of unpremeditated performance is that of a core bit drilling through the wing of a fishtail bit and then taking an eighteen-foot core. Moreover, the fishtail wing was



The inserts have been set in the core bit shown on the left which is ready for its final coating of hard facing metal. Note the inserts used to keep the bit to gauge. The bit on the right has been completely faced and is ready to run.

The granular form of diamond-hard compound is particularly adaptable to disc bits. This special type is well protected.

itself hard faced while the core bit was in good condition after completing its task.

Besides the direct economies of better and more lasting cutting edges and longer life that have resulted from the use of hard metal alloys applied to bits, there are indirect results that should be credited to these metals both in making hole and in coring. Considering the cutting edge alone, the use of abrasion resisting metals not only makes the bit last longer, but also keeps it in a workable condition up to the time it is pulled out of the hole. Speed is thus obtained by effective cutting during the entire time the bit is on bottom and is further augmented by cutting down the number of trips that must be made to replace the bit. As deeper drilling is encountered, this factor naturally increases in importance and the saving in time due to a decrease in the number of trips in and out of a hole at a seven or eight thousand foot depth is an item of cost as well as speed. Coring, at its best, has a slowing up effect and the length of core is so often governed by the ability of the core bit to cut on. If cores taken with a hard faced core bit are only twice as long as those taken with a bit not so treated, the result is a much faster and economical operation.

The amount of wear and tear on equipment during the drilling of a well is almost an indeterminate matter. A certain amount of effective rotation is necessary to make a specified amount of hole, but if the amount of ineffective rotation can be cut down, an economy of power, water, labor and wear and tear on equipment has been secured. Moreover, if the number of times the tools have to be pulled out has been decreased, an added economy is obtained. The increase in speed under such conditions is also an economic factor, while the quicker striking of the productive zone is a consummation greatly to be desired.

What is considered by some as the most valuable attribute of a hard metal is its ability to keep the drilling bit out to gauge. The advantage of having the hole at its full diameter throughout the entire depth of a well is quite evident and there is every reason to believe that a considerable amount of reaming has been prevented by having the bit properly faced with a hard metal. Furthermore, the full-gauged bit has probably been of no little influence in assisting the driller in keeping the hole straight, while the continuously sharp cutting edge has also been instrumental in decreasing the tendency of the bit to wander from the

A four-way bit after a long run.

vertical when a formation of different character has been reached. The tapering hole is, of course, conducive to stuck pipe and fishing jobs, but the prevention of such things due to the full-gauge hole can be credited to the hard metal in only an indefinite way.

It is probable that all the hard metals that have here been designated as "diamond-hard" are tungsten alloys with the majority of them tungsten carbide prepared by patented processes. Yet all manufacturers of such metals are constantly striving to perfect their products and make them meet every condition imposed upon them by severe drilling service. With few exceptions, the inserts and the granular forms rely on another metal, either of the hard facing type or other alloy, to keep them on the bit. The diamond-hard metals themselves are not melted, but are surrounded by other metals that are put into solution and into which they are imbedded. One tungsten alloy, however, is produced in a powdered form and is melted with the electric art at a temperature of about 2800 degrees C. and is thus bonded with the parent metal of the bit. Some of the inserts and granular forms are best applied with the electric arc; others should only be welded on with oxy-acetylene; and still others are equally effective with either arc or gas welding.

A new kind of diamond-hard metal has recently been developed and is interesting because it is radically different in composition from any of the others that have been so successfully used. It has been tested out on several types of bits in some of the fields in the Los Angeles Basin and has shown results comparable to those obtained with other hard metals. It is not a tungsten carbide and is both non-carbonaceous and non-ferric.

This metal is comparatively light in weight with a specific gravity of only 5.5 as compared with tungsten carbides of between 16 and 17. In laboratory experimental work it has been used on aluminum, copper and bronze as well as on steel and has been found insoluble in acids. In its development, consideration of the service it must perform was naturally taken and besides incorporating toughness with the hardness, it was aimed to make the metal more resistant to impact than had yet been accomplished with diamond-hard alloys.

While the electric arc is recommended for the application of this metal, the following characteristics would seem to make the arc absolutely necessary. It goes into solution just below the temperature produced by the arc and then returns to the identical crystalline form (but smaller in size) it had before the heat was applied. It is furnished as a powder and is made to form a homogeneous mass with the parent metal on the bit with sufficient penetration to make the resulting member a continuous piece of metal with the original body merging into the diamond-hard metal cutting edge. There is no carbon in the metal itself and any carbon taken from the bit metal will naturally be confined to that portion of the member adjacent to parent metal.

There has been no decided recent trend in the form of the diamond-hard metal being used in the California fields. Some operators prefer inserts and seem to feel there is little disadvantage in the fingering that frequently results from their use. Others have been using the granular or powdered forms to a great extent and claim that an even more effective cutting edge is secured by their use. The type of bit on which the metal is applied naturally has an influence in the form of the alloy and the manufacturers of some of the special bits have standardized on the shape of the metal to be used, although they may give the user a choice in the make that shall be applied.

TABLE

Performance of Some Disc Bits Faced with Diamond-Hard Compound in California Fields.

Ventura	1271 feet	4 sets 19" bits
Ventura	710 feet	2 sets 25" bits
Ventura	293 feet	42 hours—19"
Ventura	229 feet	45½ hours—19"
Ventura	210 feet	38 hours—19"
Ventura	282 feet	38½ hours—19"
Ventura	215 feet	28 hours—19"
Ventura	166 feet	1 set—17¼"
Kettleman	258 feet	1 run—13⅜"
Kettleman	462 feet	1 set—18"
Santa Fe Springs	1100 feet	3 sets
Santa Fe Springs	285 feet	17¼"
Santa Fe Springs	129 feet	1 day (5400—5529)
Long Beach	309 feet	average
Signal Hill	1000 feet	22"—3 days
Signal Hill	3000 feet	13⅜"—10 days
Venice	1647 feet	1 set—17" (Venice is easy drilling)

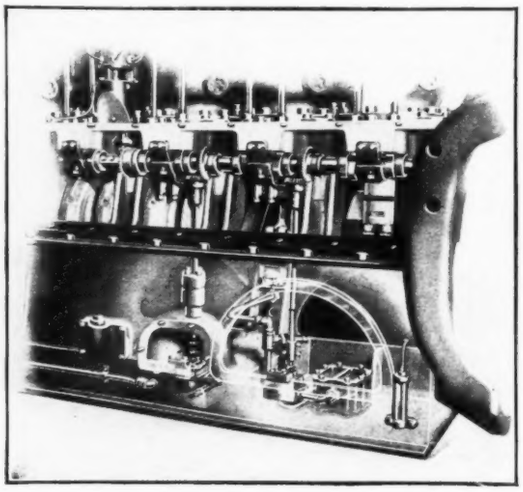
After a run of 1,976 feet and after being on bottom for 40 hours, this fishtail bit came out less than 1/16 inch out of gauge. It passed through four hard shell formations which varied in thickness from 4 inches to 2 feet. It was faced with diamond-hard metal which is readily seen to have held up remarkably well and to have kept the bit to gauge in spite of the wearing away of the softer metal between. The run was made in a well in Signal Hill, California.

Factors Involved *in the* Lubrication *of*

By ARTHUR M. TOI

THE effective lubrication of Diesel engine air compressors presents a set of requirements quite different from those encountered in the lubrication of power cylinders and bearings. In order that the air compressor may give unfailing service it must be furnished only with high grade oil of sufficient body to maintain the sealing and lubricating film under the conditions of high temperature and pressure which prevail. Undoubtedly, successful air compressor operation is dependent on the unit being served with just the right amount of the most suitable grade of oil.

The air compressor as usually installed in higher powered Diesel engines will generally have either three or four stages, and will be equipped with suitable inter-coolers. The exact quantity of air required for injection is difficult to determine; moreover, since it varies with different fuels, and the compressor must also provide air for starting purposes, ample margin is usually allowed for in the design. The compression of air to pressures in the neighborhood of 1,000 pounds will, of course, develop a considerable amount of heat; it is the function of the inter-coolers to reduce this heat and thereby keep cylinder temperatures down to minimize the extent of oil vaporization. This is, of course, in the interests of safety, for otherwise accumulations of dust and carbonaceous matter in the inter-coolers, etc., might easily so restrict the air passages as to increase the velocity and consequently the frictional temperature of the air to a dangerous extent.



View of Ingersoll Rand Company Diesel engine for locomotive service. The location of fuel oil and lubricating oil pumps and their driving mechanism are shown.

Methods of Lubrication

The lubrication of air compressor cylinders is carried out by mechanical oilers similar to the ones used for the power cylinders, but the pumps should be adapted to handle a smaller quantity of oil per stroke than is the case with the power cylinder lubricators.

To best effect air compressor cylinder lubrication, each cylinder should be equipped for force feed or pressure lubrication, whereby uniform and measured quantities of oil can be fed regularly. Only a drop or two a minute to the first one or two stages will be necessary.

The third or last stage will usually be abundantly served with oil carried up from the preceding. On the other hand, no hard and fast rule can be laid down in this regard, and the safest course to follow in determining upon the quantity of oil to use is to remove the valves at periodic intervals and examine the cylinder walls. A properly lubricated wall should be coated with a film of oil which will just barely dampen or stain a cigarette paper.

The Source and Effect of Moisture

The presence of an excessive amount of moisture in the form of free water requires careful consideration in the efficient operation and lubrication of high-pressure air compressors. While water separators are provided, in conjunction with the air inter-coolers, to remove the water from the air, this removal is rarely complete. Compressor troubles caused by the presence of water are most apparent in the final stages.

The compression of the air, with its subsequent cooling in the inter-coolers, results in the condensation of water vapor which, to a greater or lesser extent, is always present in the atmosphere. Although the separators referred to are depended upon to remove the greater part of the water, yet an appreciable amount is carried along with the high-velocity air leaving an inter-cooler and on into the next stage cylinder. The rush of this high-velocity compressed air, in a very wet condition, into the comparatively small-diameter cylinders is very detrimental to the lubricating-oil film if this is not sufficiently adhesive.

This free water which has been carried along with the air into the cylinder for final compression often has a washing effect on the lubricating-oil film. Where this may prevail the maintenance of an efficient oil film on the cylinder wall is impaired during the compression stroke and it is difficult to develop effective seals between piston rings and cylinder walls.

The lack of a proper lubricating film results in blow-by of air and excessive wear, especially toward the end of the compression stroke when the pressure behind the piston rings is at a maximum. In addition, the presence of moisture and air may cause the rusting of valves, piston rings, and cylinder walls. The development of moisture will frequently be revealed upon inspecting high-pressure air-compressor cylinders after the unit has been shut down. The rust formation which will inevitably follow causes pitting of valves and forms a grinding substance between piston rings and cylinder walls which results in further wear.

To meet the above requirements, it is customary practice to compound many oils for Diesel engine air-compressor service with a small percentage of high-grade fatty oil, which will render the resultant product especially adherent to wet metallic surfaces. A properly prepared air-compressor oil is capable of developing and maintaining a tenacious water-resisting lubricating film while in service, and also preventing rusting or corrosion of the cylinder walls as well as the piston and rings during idle periods.

Overheating and Flash Point in Air Compressors

The subject of the heat due to compression causes some confusion in the minds of operators as to the interpretation of the flash points of lubricating oils for air compressors. Flash-point readings are of value only as an indication of the relative initial volatility of different oils, and are not definite temperatures at which they "boil" or go completely into vapor corresponding to the boiling point of water.

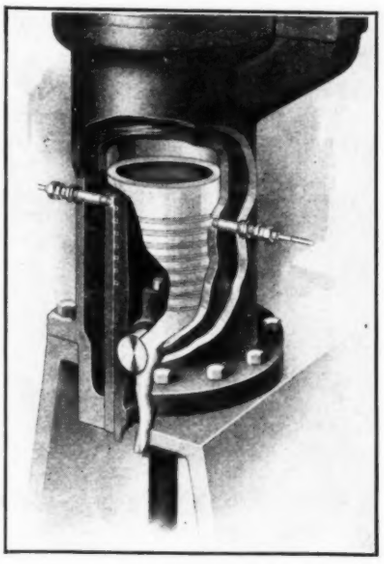
# of Diesel Engine Air Compressors

TODE, M. E.

Oils of the proper consistency which leave unusually low carbon residues are much to be preferred to oils of high flash point. Certain engineers, however, in their eagerness to secure oils of high flash point, will frequently overlook this matter of subsequent carbon deposits. This is, of course, erroneous.

It is sometimes assumed that a high flash point is a desirable quality of a lubricating oil for air-compressor service. The thought is that a high flash point will prevent the loss of oil from the cylinder walls through evaporation, thereby lessening the danger of explosions. However, laboratory tests have been made with high-quality light-body lubricating oils having a flash point between three hundred and ten, and three hundred and twenty-five degrees Fahrenheit. These tests showed that negligible quantities were distilled off up to a temperature of about six hundred and fifteen degrees Fahrenheit, at atmospheric pressure.

It appears that the rapidity of evaporation of an oil, as well as its tendency to carry oil vapors from the cylinder wall film over into the discharge pipes and inter-coolers is not governed by the flash point alone. Moreover, it appears that even with such an oil of too high a viscosity for compressor lubrication, a temperature of about six hundred degrees Fahrenheit would not generate sufficient vapors to form an explosive mixture. The discharge temperatures in air compressors range in the neighborhood of three hundred and twenty-five degrees to three hundred and seventy-five degrees Fahrenheit, and since the cylinder walls are always jacketed it is natural that the oil film on the wall has a temperature lower than the discharge air.



(Courtesy S. F. Bowser and Company, Inc.)

The number of points at which the lubricant should be applied to the piston of a Diesel engine depends upon the type of engine and size of cylinders. Usually two to four points of application equidistant in the circumference of the cylinder wall will suffice, although on larger Diesel engines the points of cylinder oil introduction will increase in number.

Over-Lubrication Must Be Avoided

Even the best oil is at times carried over with the discharge air in liquid form when compressor cylinders are over-lubricated. This discharge air sweeping over the wetted surfaces carries small globules of oil along with it. The result will be an accumulation of oil and carbon deposits on the discharge valves which are directly in the path of the hot discharged air. Not being separately cooled like the cylinder walls, these valves have the highest temperature of all compressor parts. This is further proof that high flash point oil is unnecessary as these high valve temperatures cannot condense oil vapors from the colder cylinder walls. It must, therefore, be assumed that carbon which is found on the discharge valves leaves the compressor along with the air.

Oils too heavy in body for compressor use will tend to deposit more carbon than an oil of the right body. Furthermore, heavy body oils distribute very slowly and require excess feed to assure a complete lubricating film being maintained. Over-lubrication, especially where a high carbon residue oil is used, promotes carbon and may be the cause of air compressor explosions. Consequently not only must an oil be most carefully selected, but also, whatever its characteristics, the utmost care should be taken to prevent the use of more oil than is necessary.

In this respect, it is very difficult for some operators to realize that but one or two drops of oil per minute is all that is necessary. This is effectively counteracted in many Diesel air compressors by so designing that the intermediate stage is at the bottom. As a result of such construction there is always a pressure opposing the tendency of the oil to work up into the air space from the lowest cylinder wall where it is thrown by the crankpin.

Eliminate Dirt and Carbon Deposits

Inasmuch as the lubricating oil may cause, or lead to deposits of more or less intensity, depending upon its carbon content and the operating conditions involved, more discussion in this regard will be of interest.

Deposits of carbon plus dirt on the valves, or in the discharge lines of an air compressor are to a certain extent caused by decomposition of the oil. It is an accepted fact that mineral lubricating oils, regardless of their base or nature, will decompose to volatile products and carbon when subjected to hot air under pressure. The extent of this decomposition of course depends on the length of time the oil is exposed to such heat. Naturally, it will also follow that the oil which remains in the compressor cylinder or on the discharge valves the longest, will form the greatest amount of carbon.

On the other hand, analysis of numerous so-called carbon deposits has proven them to consist more of dirt than of carbon, the whole being held together by gummy matter from decomposed oil. For this reason, a compressor oil having a wide range of distillation, high end point, or too great a viscosity is objectionable, inasmuch as, instead of vaporizing cleanly, it breaks down as has been mentioned above, becoming sticky and collecting dirt brought in by the air. The slower the breaking down process, or the greater the volume of oil involved, the more carbon will ultimately be formed.

Pale filtered oils, properly refined, are very free from both direct carbonization and the collection of carbonaceous matter. Furthermore, any such direct carbon that may be formed through excessive use is of a light, fluffy nature. Carbon deposits formed from improperly refined or unsuitable oils, on the other hand, are often of a hard, flinty nature. Any oil, however, will accumulate dust if the air is dirty. While dirty air is perhaps one of the most general causes of accumulation of foreign matter, yet, as has been pointed out, an excessive amount of lubricant will tend to develop carbonaceous matter which will materially increase the accumulation of deposits.

In addition, an excess of oil fed to the compressor cylinders may bring about leaky valves due to a certain amount of the oil becoming carbonized on the latter. All this, of

course, leads to a decrease in operating efficiency for this carbonaceous matter being relatively sticky in the early stages of its formation, will also tend to adhere to the piston rings, thereby causing them to become inoperative; furthermore, it will tend to destroy the lubricating film and result in scored cylinders.

Unfortunately there is no oil which will not deposit some carbon. On the other hand, there is a surprising difference in the characteristics of the carbon which will be developed by different oils.

Relative to Air Compressor Explosions

The different stages of air compressors are so arranged as to compress the air at the same ratio correspondingly, so as not to overheat the valves and springs; also, to obviate the danger of lubricating oil vapors becoming ignited with consequent explosion.

The matter of explosions is of the utmost importance to all who have to deal with air compressor operation and lubrication. Explosions occur due to accumulations of carbonaceous matter becoming heated to the point of combustion when abnormally high temperatures are involved due to leaky valves, either causing the metal to burn through and blow out, or bringing about the ignition of gaseous (oil and air) vapors which may have resulted from oil collections in pockets, etc. Localized vaporous accumulations of this nature will practically always become sufficiently condensed in time to form a "critical" or combustible mixture of air and oil vapor, requiring only intense heat or a spark from incandescent carbon to bring about an explosion.

Two distinct factors, therefore, require consideration, i. e.:

1. The extent to which carbon deposits or accumulations of dust, dirt and oil, etc., are involved, and

2. The generation of excess heat, due either to air leaks in the discharge or final state of compression, especially at the time of "unloading", or increased velocity of flow through the lines.

Carbon deposits or "carbonaceous" matter in general does not strictly denote pure carbon, or, in other words, carbonized oil. In fact, the proportion of fixed carbon to volatile matter in many cases will be relatively low.

Silica, iron, copper and zinc have all been found present, proving that a considerable portion of any such deposits can therefore be regarded as consisting of substances which are either drawn in by the original charge of air, or abraded from the metallic parts of the system, the lubricating oil being but partially responsible.

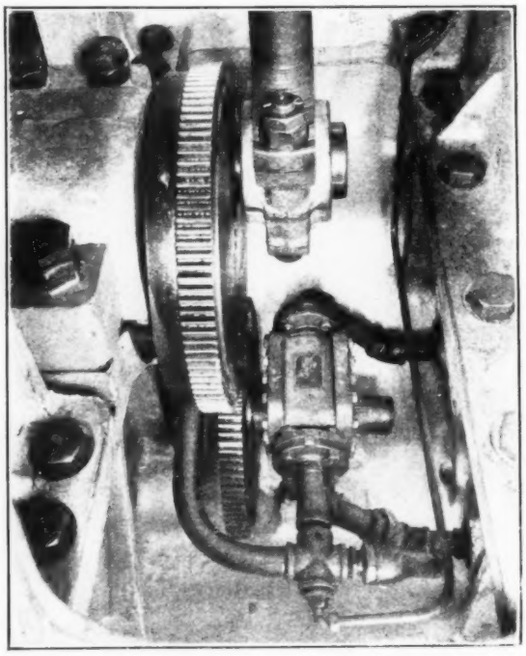
Cases of air compressor explosions which have been investigated carefully have suggested that the cause was excessive carbon deposits on discharge valves, piping and intercoolers which had restricted the area of the passages. Such accumulation may interfere with valve seating. Leaking discharge valves may result in a rapid increase of the compressed air temperature to a degree far above the highest flash point of any lubricating oil. The abnormally high temperatures of the air causes the carbon deposits to become incandescent which, in turn, will result in a rapid formation of oil vapors from these deposits as well as from any excess lubricating oil present in liquid form. An explosive mixture is thus formed with the hot compressed air, which is eventually ignited by the incandescent deposits.

It is very desirable to clean out the air-compressor system at intervals and wash out the carbon deposits before they grow to large proportions. Kerosene or any similar light oil must under no circumstances be used for this purpose, because of the danger of explosive mixtures due to their high volatility, and the comparatively large quantity used.

Some operators look with favor on the use of soapsuds for cleaning, the solution of soap and water being fed into the air intake or through the lubricator about ten times as fast as the usual oil supply. The quantity used must be judged by the amount of carbon found on the valves when they are inspected. After such an application all receivers must be blown down to remove all the soapy water, and oil used again for a time before shutting down, in order to prevent rusting.

THIS MONTH'S COVER

Our cover this month is a reproduction of a drawing by Paul Proehl, Chicago, depicting oil field activities in the Texas Panhandle. The remarkable way in which the artist has put the spirit of the oil fields onto paper bespeaks his thorough training and wide experience with industrial subjects. The drawing is one of a series in which International trucks have appeared and we are grateful to International Harvester Company of America for its use.



A lubricating oil pump located in the crankcase of a four-cycle Busch-Sulzer Diesel engine. This is a positive pressure, gear-driven rotary unit, designed to deliver oil to the main, crank, and wrist pin bearings under a pressure of from 10 to 12 pounds.

CAUSES *of* FURNACE WALL FAILURE

By GEO. P. REINTJES*

EVERY furnace, whether a boiler, still or other type of furnace, can be divided into three parts—namely, the method of supplying the fuel and its combustion, confining of the products of combustion and the delivery of them to or through the product to be heated, and the method of conveying the product to be heated to the heated gases. If there were no losses between the generation of heated gases and the exit of the spent gases through the stack, we would have an efficiency of 100 per cent. Some losses cannot be prevented, others can. Some of the preventable losses are what we will consider in these articles.

This is the first of a series of articles on furnace brick work. This series is written to assist refiners in saving in fuel costs and excessive repairs, as well as means of prolonging the life of furnace walls.

Combustion engineers have developed the highest efficiencies in the design of oil and gas burners as well as method of burning the various solid fuels, and refinery engineers have mastered the art of heat transfer in all its branches.

For years the engineers have transferred the heat to the product to be heated in two ways—by direct radiation and by convection. Heat by convection is transferred to the product to be heated by direct contact, whereas radiant heat is reflected to the product. Radiant heat is reflected to and from the refractory walls, also from the incandescent particles of fuel burning in suspension.

The greater the furnace temperature, the more complete will be the combustion of the fuel. A clear, cherry red flame has a temperature of 1,830 degrees F., while a bright white flame has a temperature of 2,550 degrees F. Very few gases will ignite below 1,022 degrees F. In boilers the temperature of steam at 150 pounds pressure is only 358.5 degrees F., and at 250 pounds pressure it is 401.1 degrees F. The oil in stills reaches a temperature of 900 degrees F.

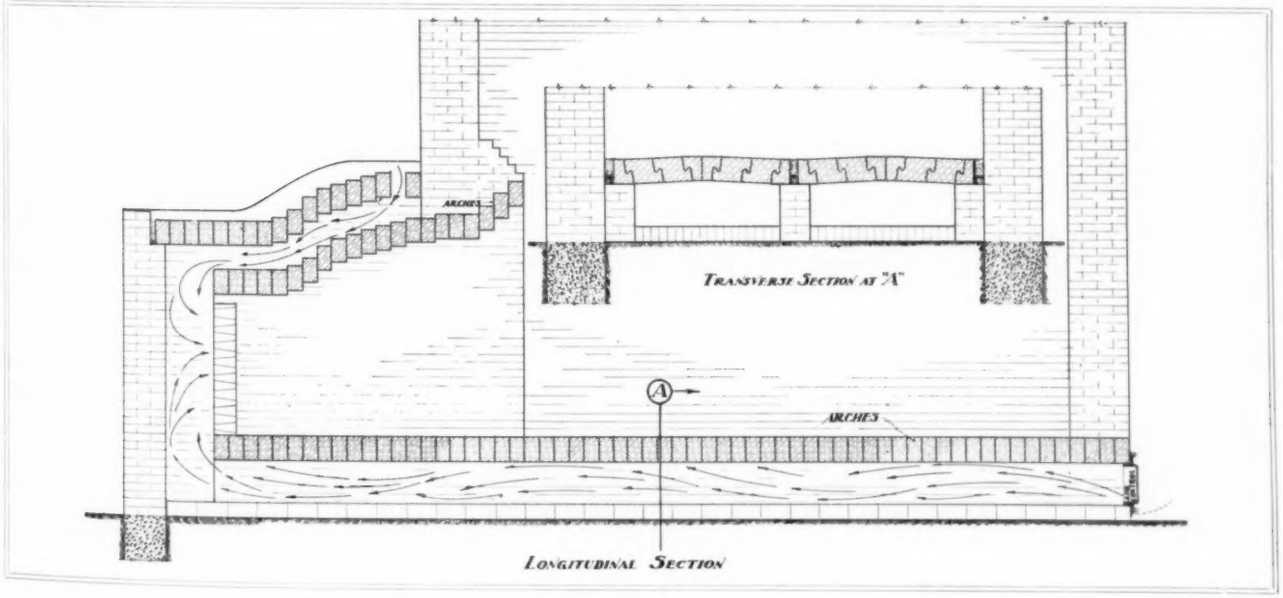
If it requires in excess of 1,500 degrees F. furnace temperature for economical combustion, all fuels must be completely consumed before the gases reach the comparatively cool tubes. Should the unburned fuel touch the tubes of a boiler, carbon deposits would form, insulating the tubes from absorbing the heat. Burning particles of fuel in suspension reflect an intense radiant heat. The temperature to which the oil is heated being so close to the temperature at which still tubes will fail, it is imperative that only a soft heat be reflected to heat the tubes. The allowing of an excessive amount of particles of fuel in suspension is one of the primary causes of tube failure.

Combustion engineers use various methods of reducing this condition. Some build protecting walls in front of the radiant wall tubes to divert the flame travel. Others use recirculated gases, still others complete the primary combustion in so-called "dutch ovens" in front of the stills. In the latter method the refractory walls are heated to an incandescent temperature by the restricted combustion area and the refractories in turn reflect the heat to the particles in suspension and speed up combustion. The engineer must take care, however, that the gases are released from the "dutch oven" as soon as combustion is completed, so as not to build up a temperature that will destroy the refractories.

A method of doing this is by using a flat arch, with this design, individual ovens being used for each burner, utilizing the radiant heat of four sides. The cross-sectional area is increased for the expanded gases. Then, too, the burner may be moved forward with the use of a curtain wall to suit the individual operating conditions without disturbing the side walls or roof. Heat has been known to penetrate eight to ten feet below the floor line. In building an air-cooled floor, the fewer supports used, the greater will be the insulating value and the less friction loss to the air flow. It is preferable to use a separate air lane to each burner.

With proper furnace design and operation, the efficiency of the furnace is dependent entirely upon the design of the furnace walls and upon the workmanship of erection, which will be discussed in a later article.

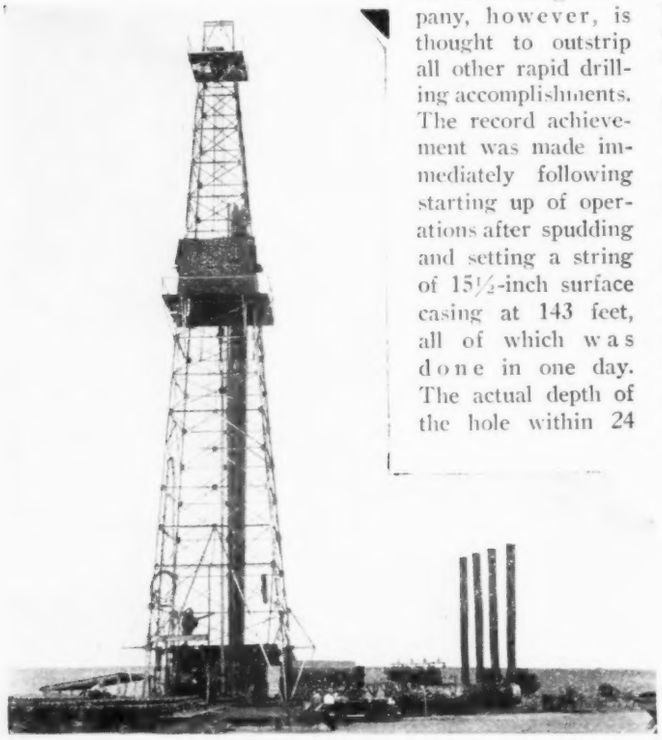
* Geo. P. Reintjes Co.



2393 Feet Drilled in Record 24-Hour Run

HIGH drilling speeds have contributed several outstanding performance records during the past year, among which is a new world's footage mark for a 24-hour run made by the Olson Drilling Company, Tulsa, when 2,393 feet of hole was drilled, an average of nearly 100 feet per hour, in a continuous 24-hour period.

Extremely fast drilling time has been a feature of operations in many parts of the country, especially in the East Texas and Fort Morgan (Colo.) areas. The feat of the Olson Drilling Company, however, is thought to outstrip all other rapid drilling accomplishments. The record achievement was made immediately following starting up of operations after spudding and setting a string of 15½-inch surface casing at 143 feet, all of which was done in one day. The actual depth of the hole within 24 hours after drilling was resumed was below 2,500 feet. However, after deducting for the amount of surface hole prevoiusly drilled, the 24-hour run was just short of reaching 2,400 feet.



This extremely fast drilling time is a tribute to the skilled workmanship of the drilling crew and is an accomplishment of much pride to the contractor and to the equipment manufacturers. An average of slightly better than three joints of six-inch drill pipe was added to the drill stem column every hour during the run, but during early drilling the record was much faster; frequently additional drill pipe was required within five minutes after stabbing a previous joint.

The equipment installed on the rig was the latest and heaviest, modern type rotary drilling machinery, steam for which was generated by four 125-horsepower, 350-pound working pressure boilers. Two 14½x7¼x20 duplex steam slush pumps handled the mud pumping problem in fine fashion.

This remarkable accomplishment was made by the company when drilling the Colorado Associated Oil Company's Juniata Pumphrey farm test in 14-4-58w, just north of Fort Morgan, Colo., and approximately 20 miles south of the Greasewood field. A string of 5,810 feet of 8⅝-inch, 44-pound casing has now been set in the well. Drilling had consumed approximately 20 days time prior to shutting down to run the 8⅝-inch pipe. The only delay in drilling was experienced from boiler feed water, which in the latter part of the hole was overcome by chemical treatment.

Some other unusually fast drilling times have been made in the Greasewood field by several contractors, but none has as yet equalled the record established by the Olson Drilling Company. The extremely fast drilling runs in all instances have been in the surface formations, which are soft and easily penetrated.

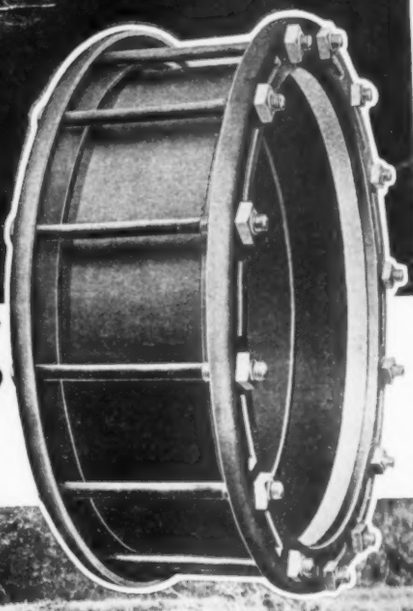
The Fort Morgan district has been the scene of many interesting drilling jobs in addition to fast boring speeds. The problem of high bottom hole temperatures has required precautions and rapidity in placing cement behind the casing. The East Texas fields have also been the scene of some extremely rapid drilling. Smith & McDannald, contractors, drilled the Tidal Oil Company's Thompson No. 1 to a depth of 3,725 feet in five days time, including setting of surface casing.

The drilling record of the Olson Drilling Company adds another important achievement to the many interesting drilling accomplishments of the year 1931, which has seen three tests penetrate below 10,000 feet, witnessed the running of several unusually long and heavy casing strings, and saw the establishment of a new speed record in cementing a 5,500-foot string of pipe.

(Above) Colorado Associated Oil Co.'s Juniata Pumphrey No. 1. (Below) Record-making drilling crew and some company officials.

On Missouri Valley Line (24 INCH)

DRESSER COUPLINGS DOMINATE



S.R. DRESSER MANUFACTURING CO.
BRADFORD, PENNA.

Pure Oil Company's Michigan Deep Well Central Power Successful

THE successful application of central power pumping for shallow wells has long been recognized, but it is only within the past few years that this type of equipment has been employed to pump deep wells. There are a number of installations of this character serving wells deeper than 3,000 feet in the Mid-Continent and California. A central power installation serving 16 wells having an average depth of 3,585 feet has been made on the Pure Oil Company's W. D. Gibson lease in the Midland district, Isabella County, Michigan.

This locality, which is characterized by a level terrain, is ideal for this type pumping, as the running of shackle rod lines presents no difficulties and the wells are of easy access for pulling. The Gibson plant, built under the supervision of J. M. Lantz, division superintendent of production, has been completed a year and a half. It has operated during this time with no repairs and with negligible operation expense.

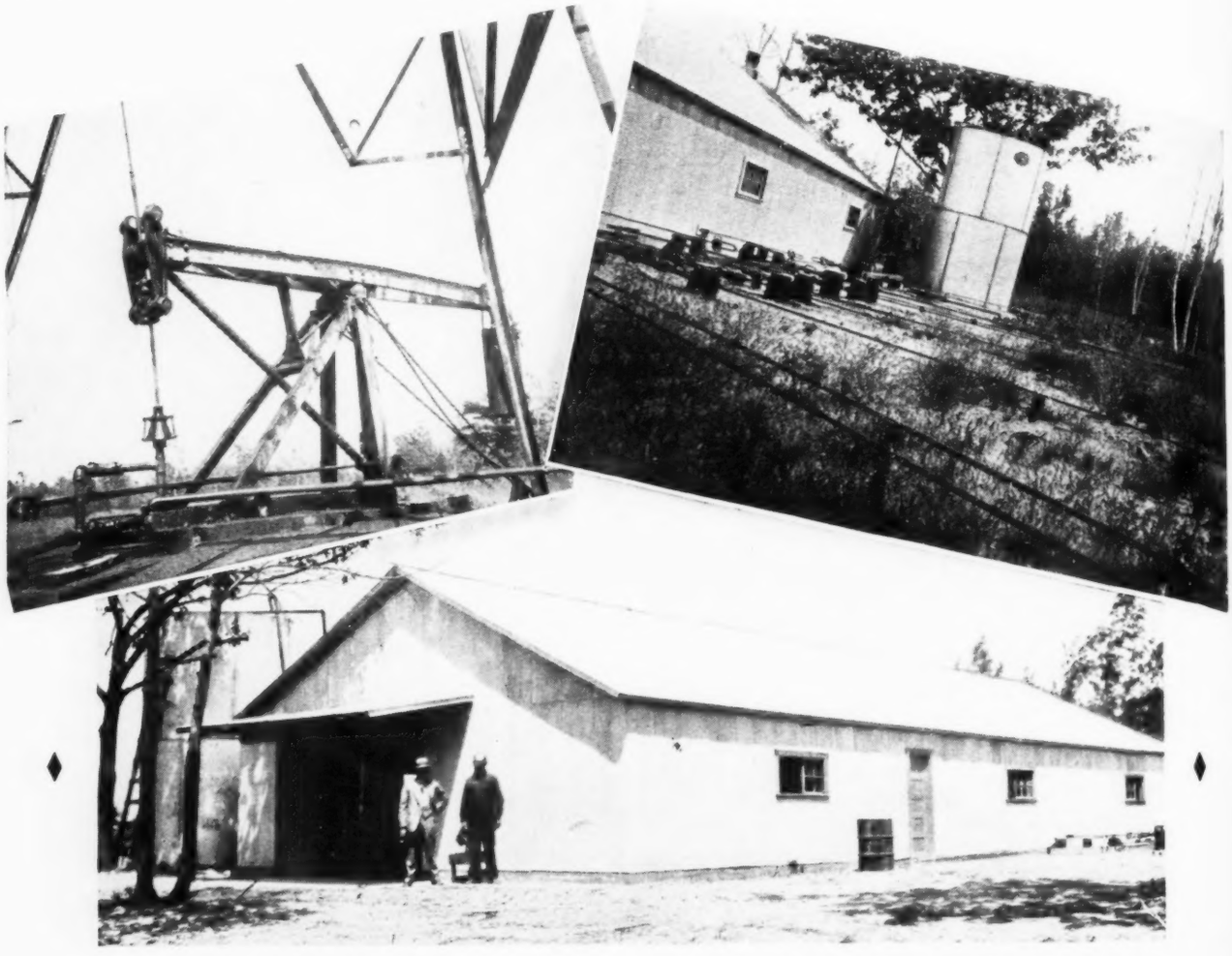
The plant proper consists of a 24-foot double eccentric bandwheel power, belt-driven by a 60-horsepower gas engine, with idler and other accessory equipment, all of which is housed in a 30x78-foot galvanized iron building.

The wells are equipped with jacks of a heavy-duty, underpull type, suitably counterbalanced. Because of the heavy loads imposed, the majority of these jacks are set on concrete foundations, and all equipment used in connection with the power is of a much heavier type than commonly employed throughout the eastern divisions.

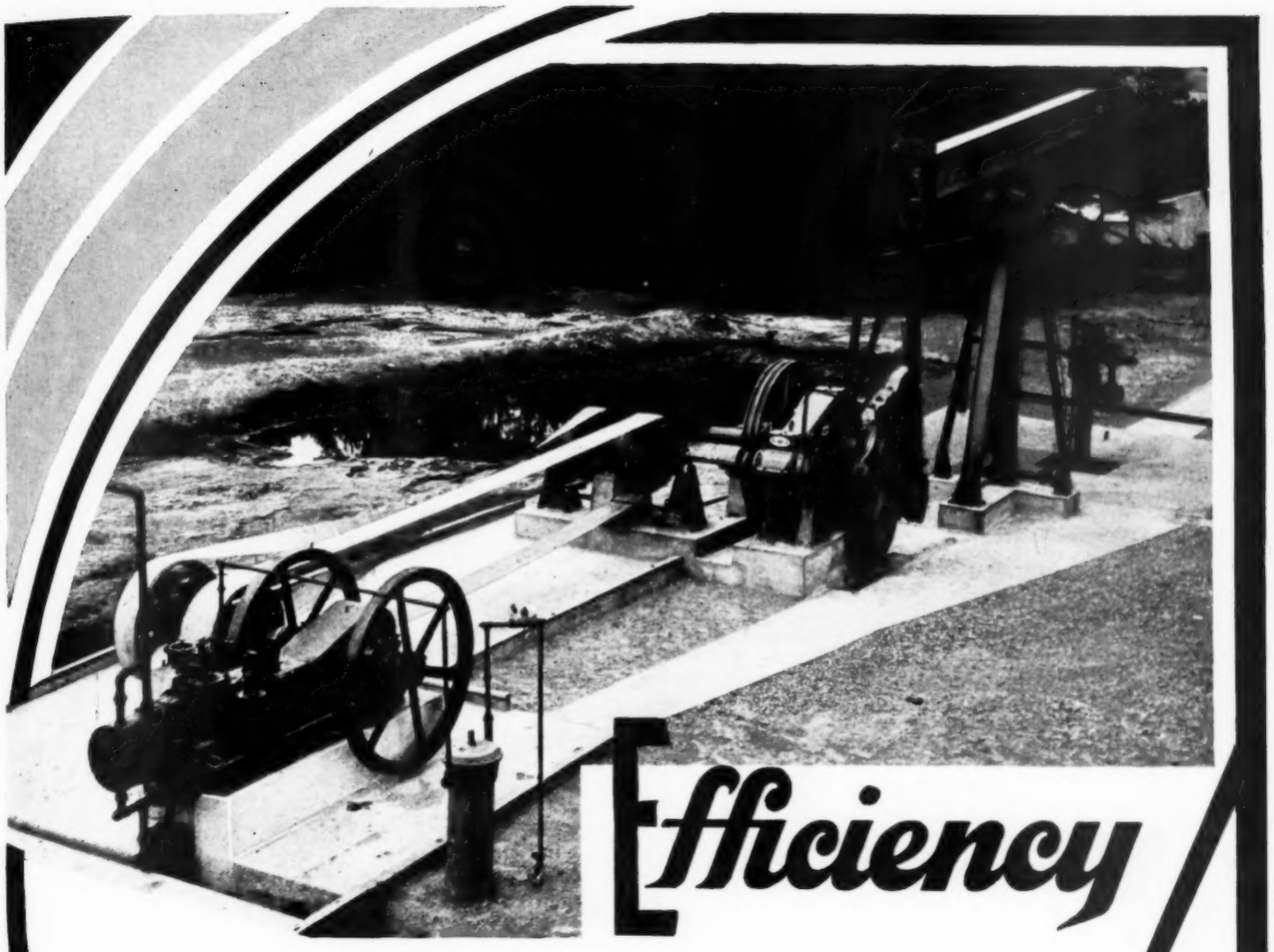
Pumping motion is imparted from the power plant by the use of ¾-inch and ⅞-inch pull rods, and the most modern safety type hook-off and hook-on equipment is used. The pull rod lines, which are supported in the usual manner, vary from 340 to 2,050 feet in length and have given no trouble during the time the plant has been in operation.

The wells are operated at an average of sixteen (28-inch to 34-inch) strokes per minute, with provision made to vary pumping speeds and length of stroke as required to meet general operating and individual well requirements. The wells are serviced with a winch-equipped tractor. There has been little or no pulling of cups. Pulling jobs to date have been largely confined to paraffin deposition in the tubing.

This model plant immediately impresses the visitor with its general efficiency of operation.



(Upper left) Heavy-duty jack on Gibson lease. (Upper right) Shackle rod line knockout posts and shackle lines. (Below) View of central powerhouse.



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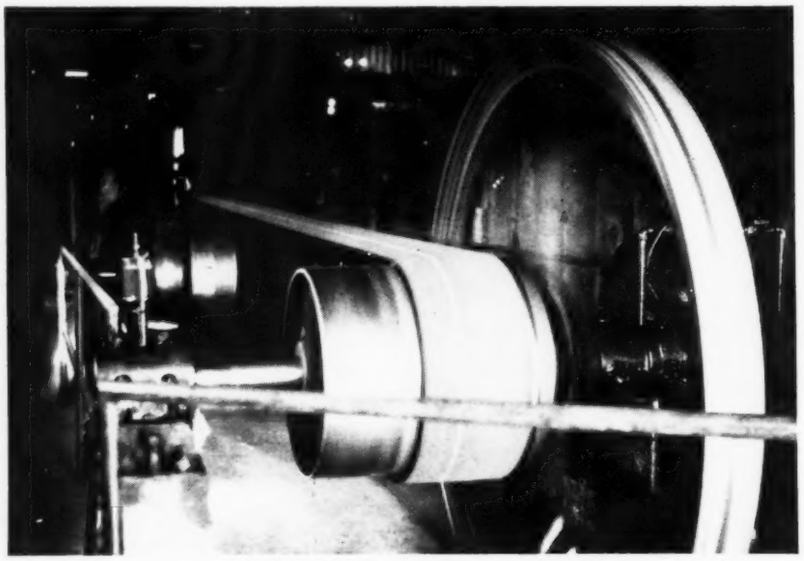
Field Records Indicate Progress in Use of Belts

BELTS, long a common means of transferring power from prime movers to pumping equipment, have in the past few years been wonderfully improved, and marked improvement in oil field care and installation has resulted in much less trouble being experienced than heretofore as is noticeable from field records on belts.

When pumping equipment was first being installed in the Greater Seminole field (1929), the average life of a belt was about nine months, but in the same field the life of a belt has now been increased to a year or more, with several companies securing an average of 15 months' service. This has been accomplished through more attention to clamps and improvement of band wheel faces together with improvements in the belts themselves.

Early belts installed in the Seminole field were of 14-inch width, but now many wider belts, up to 22 inches, are being used. One company using this wider belt has had less shutdown time from belt trouble than ever before.

More and more the endless type belts are being adopted, on which clamps are unnecessary, and these also permit a few turns of the idler to take up all the stretch. Another thing favoring the endless belt is the easier installation in the field and the lessened possibility of a gang crew making too tight an installation.



Belt installation from engine pulley to countershaft on beam pumper in Seminole field.

A new belt has considerable stretch and care should be taken in seeing that this elasticity is not entirely taken out when the belt is first installed if the belt's life is not to be shortened. In installing, it should be seen that only sufficient tension to keep the belt from slipping is applied and that the belt ends are square so as to secure an even pull.

Another important factor in securing longer service from belt drives has been a better understanding of what constituted the proper pulley. With the wider pulley and belt now in use the area of contact is larger, consequently dividing the load over a bigger surface. All pulleys should be carefully centered and balanced and the shafts in perfect alignment.

Most of the clamp trouble at Seminole has been with bolts. The majority of Seminole superintendents are now using larger size bolts than they did a few years ago, having adopted three-quarter-inch bolts. Clamp failures are due mostly to misalignment, loose bolts, improper placing of bolts and improper size of bolt holes. An important factor in securing longer service from bolts and belts has been the general adoption of the practice of not placing the second row of clamp bolts directly behind the first row but placing them so they occupy the space between. This will prevent the pull from being on the same threads and will distribute the belt pull more evenly.

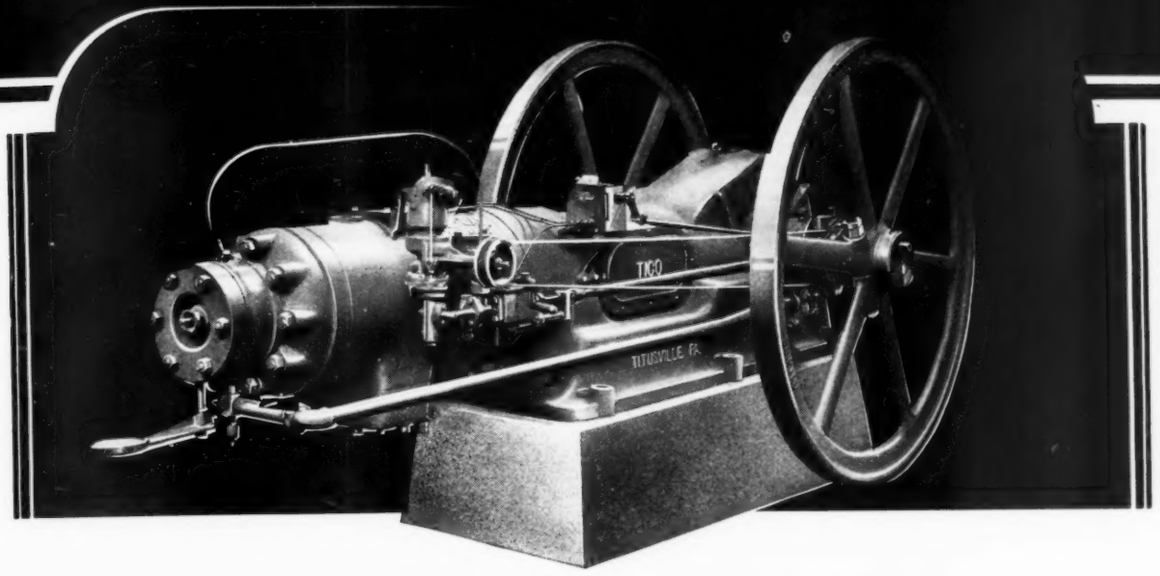
All belts should be periodically inspected. Any accumulation of dust, dirt or grease should be removed and a smooth surface restored. If it is necessary to use belt dressing the belt manufacturer should be consulted as to the proper kind and it should be applied only in small amounts so as not to weaken the belt strands.

Another increasing type of belt drive is the Multiple V-belt installation, particularly on electric motor units. These have proven very satisfactory in actual service and are being used in all divisions of the industry with equal success. Very frequently in belt drives of this type one or more belts will be noticed sagging to a greater degree than adjacent belts and conclusions are often quickly reached that the particular belts are stretching badly. Belt stretch in most cases, however, is not the main cause of unequal sags. The greatest trouble is usually found in the sheave itself, due to rust or foreign material being deposited on one or both sides of the groove or a slightly rough machined groove side. Any of the above items will make the belt ride high in the groove, giving the belts an appearance of sagging. Considerable interest is now being manifested in the short center type of drive. This is partly due to economy of floor space, together with increasing use of electric motors as prime movers.

A number of things to be considered in determining whether a belt is giving satisfactory service are: Depth of well, weight of well, number of days in service, cost of belt, maintenance cost, including record of time to repair and cost of material and crew, and the amount of fluid lifted.

No one kind or type of belting will serve all purposes with equal satisfaction no matter how used. There are many types and drives for belt application and a careful decision should be made before selecting the type best suited to the purpose.

Now Producers have a DEPENDABLE Oil or Gas Convertible PUMPING ENGINE



New TICO CONVERTIBLE

FROM GAS TO OIL OR OIL TO GAS FIRED IN 2 HOURS

The fuel economy of the dual-operating TICO CONVERTIBLE is matched by its ruggedness, dependability and simplicity. Any experienced pumper can convert the unit in two hours from either fuel. Only a minimum of auxiliary equipment is necessary for conversion from gas to oil.

Producers hailed this new Tico engine as being among the first real units of its type to make its appearance in the Oil Fields. The subsequent records established after actual operation bear ample testimony that it is a fitting companion to the famous Tico Pumping Engine. For additional information regarding construction features and dimensional data, write International Supply Company.

Made by THE TITUSVILLE IRON WORKS COMPANY at TITUSVILLE, PA.

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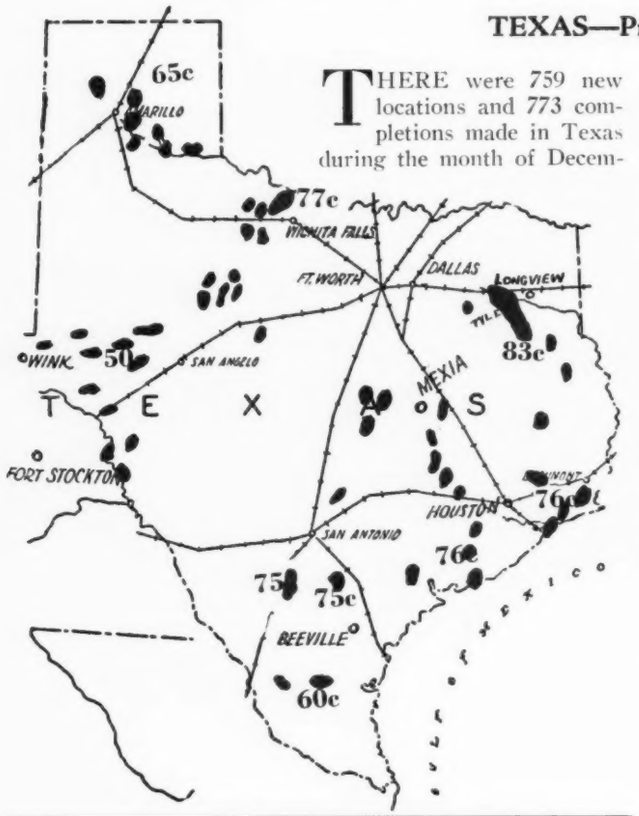
INTERNATIONAL SUPPLY STORES

Latest Activities *in the* Oil Fields*

TEXAS—Production, 1930—290,720,000 Barrels



THERE were 759 new locations and 773 completions made in Texas during the month of December, at the close of which time the state had 367 rigs and 720 drilling tests. Practically the entire number of these are located in the East Texas fields.

Drilling operations in East Texas field have been retarded recently by severe rains that have made it practically impossible to get to many of the wells and impossible to get heavy equipment to some of them.

Following is a tabulated review of the active areas:

	POOLS			
	East Texas	Panhandle	Van	Refugio
Number of Permits	596	18	11	1
December Completions	553	14	9	2
Number of Rigs	198	15	1	0
Number Drilling Wells	370	25	10	3
Gravity of Oil	40	40	36	26
Depth of Production	3600	2900	2600	6500
Type of Tools Used	Rotary	Rotary	Rotary	Rotary
Number of Casing Strings	2	2	2	2

CALIFORNIA

Production, 1930—228,612,000 Barrels

A total of 25 tests were completed in California during the month of December, during which time 12 new locations were staked. The state had 16 rigs and 141 drilling tests at the close of the month.

California activity is closely regulated by strict proration orders, and has no field developments that are at present threatening to break away from regulations imposed by the state

A survey of activities in principal fields follows:

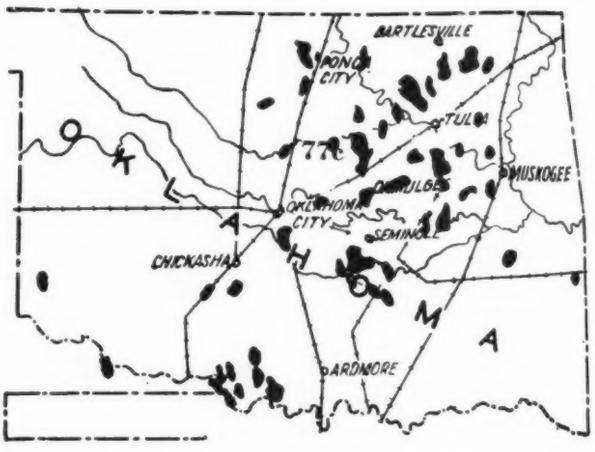
	POOLS			
	Playa Del Rey	Long Beach	Kettleman Hills	Ventura
Number of Permits	0	2	0	0
December Completions	1	4	4	1
Number of Rigs	0	1	3	0
Number Drilling Wells	3	16	11	4
Gravity of Oil	23	26	60	36
Depth of Production	6000	7000	8300	7800
Type of Tools Used	Rotary	Rotary	Rotary	Rotary

*All statistics as of January 1st.

● Denotes oil and gas fields.

OKLAHOMA

Production, 1930—214,425,000 Barrels

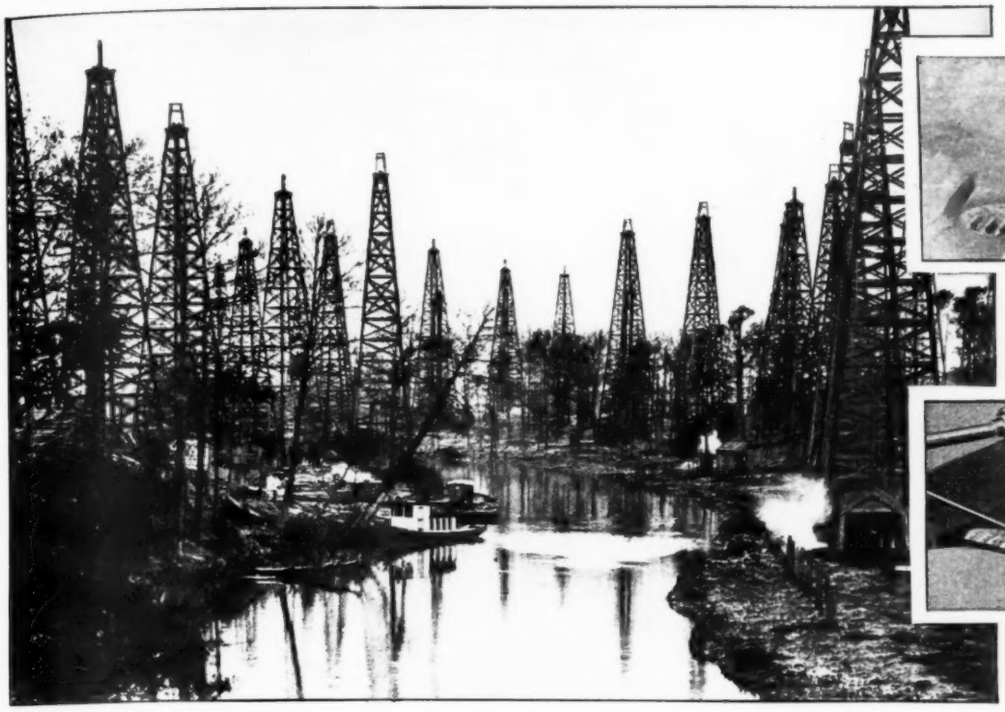


For the second consecutive month Oklahoma showed a slight increase in the number of drilling tests, but the number remains quite low.

Following is a summary of Oklahoma's activity:

	Entire State	Oklahoma City
Number of Permits	84	13
December Completions	61	9
Number of Rigs	47	20
Number Drilling Wells	126	30
Gravity of Oil	36 (average)	39
Type of Tool Used	Cab.-Rot.	Rotary
Number of Casing Strings	Varies	3

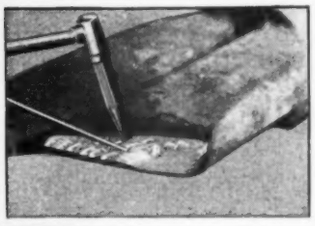
Figures on maps indicate average prices of crude oil per bbl.



E. GALLOWAY

HAYSTELLITE

Small pieces of Haystellite, the cast Tungsten-Carbide diamond substitute, welded in place.



Surfacing a Haystellite hard-set bit with Haystellite-Composite Rod (patent pending).

Red-Hardness Means Economy You Can Count Upon

IF only one fishtail bit set with Haystellite and faced with Haystellite-Composite Rod drilled 400 feet through shale, sand and limestone, and was only 1/8 in. out of gauge when pulled, the record would be interesting merely as a freak. But when bits protected with Haynes Stellite products equal and surpass this footage every day, oil men are interested because these results indicate maximum footage at minimum cost.

Haystellite is a cast tungsten-carbide alloy which combines great hardness with toughness sufficient to resist the impact of the drilling operation. Haystellite-Composite Rod is a combination of crushed Haystellite and a tough steel binder. These wear resisting products are easily applied by oxy-acetylene welding. The crushed Haystellite possesses the same excellent physical properties as the larger sizes of Haystellite and is uniformly distributed throughout the rod. This results in even distribution of the Haystellite on the cutting edges of the drilling tools.

The combination of uniform sizes of Haystellite and a subsequent facing of Haystellite-Composite Rod is the last word in hard facing oil well drilling tools.

If you are interested in reducing your drilling costs, write today for further information.

HAYNES STELLITE COMPANY

Unit of Union Carbide and Carbon Corporation

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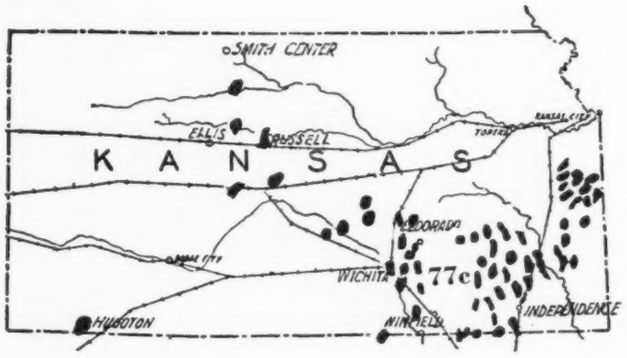
CHICAGO CLEVELAND HOUSTON DETROIT LOS ANGELES NEW YORK SAN FRANCISCO TULSA

General Offices and Works—Kokomo, Indiana

Haynes Stellite alloys are available also at all of the 42 apparatus shipping points of The Linde Air Products Company

KANSAS—Production, 1930—41,745,000 Barrels



Sixty-three new drilling permits were issued in Kansas last month and 44 tests were completed, while 44 operations were listed as rigs and 76 wells were drilling. Both rotary and cable type tools are used in the state, with the latter predominating.

Following is a summary of the active fields:

POOLS

	Sedgwick County	McPherson County
Number of Permits	11	18
December Completions	7	17
Number of Rigs	0	17
Number Drilling Wells	10	25
Gravity of Oil	39	38
Depth of Production	2900-3500	2900-3400
Type of Tools Used	Rot.-Cab.	Rot.-Cab.
Number of Casting Strings	2	2

ARKANSAS

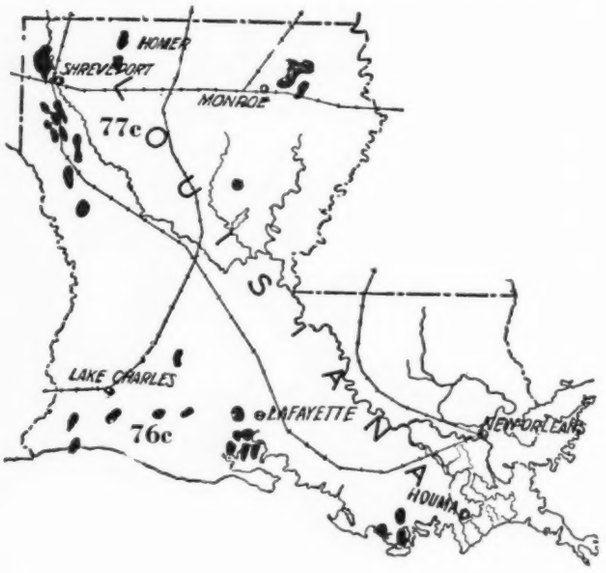
Production, 1930—19,680,000 Barrels

Oil field activity in Arkansas last month was comprised of 2 new drilling permits, 9 completions, 5 rigs and 24 drilling tests.

Rotary tools are used by contractors and operators for drilling in the state, where frequently heavy gas pressures are encountered.

LOUISIANA

Production, 1930—23,150,000 Barrels



There were 20 new locations and 38 completions made in Louisiana during December, at the end of which month the state had 11 rigs and 75 drilling tests. Rotary tools are operated in both the Gulf Coast and North Louisiana regions.

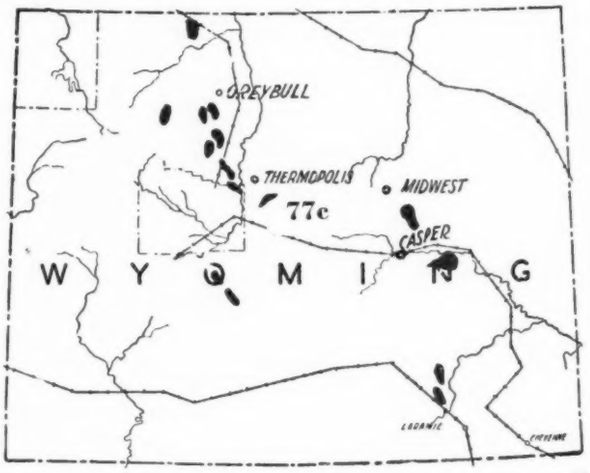
Mississippi, adjoining Louisiana to the east, had 10 completions, 8 rigs and 17 drilling tests. The Jackson gas area is the site of most of the activity in this state.

●Denotes oil and gas fields.

WYOMING

Production, 1930—11,177,000 Barrels

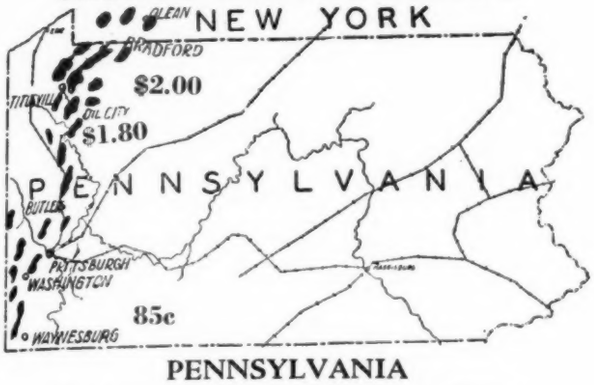
There were 5 completions, 7 rigs and 72 drilling tests in Wyoming last month. Practically all the tests in this state are drilled with cable tools.



Figures on maps indicate average prices of crude oil per bbl.

NEW YORK

Production, 1930—3,825,000 Barrels



PENNSYLVANIA

Production, 1930—12,810,000 Barrels

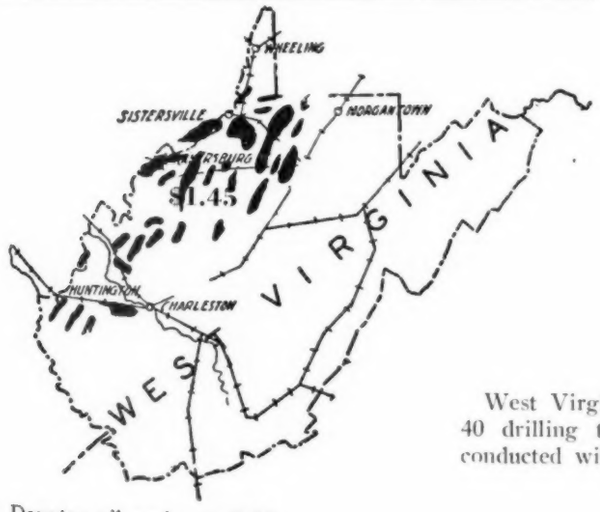
One hundred and twenty-one tests were completed in Pennsylvania, many of them being old wells deepened and new wells drilled in water flooded zones. Other activity consisted of 23 rigs and 110 drilling tests. New York had 23 completions, 3 rigs and 18 drilling tests. Cable tools are used in both areas.

ILLINOIS

Production, 1930—5,695,000 Barrels

There were 2 completions made in the state of Illinois in the month of December, while 1 rig and 16 drilling tests made up the remainder of oil field activities.

Operators in the state use standard type tools for drilling purposes. The producing horizons are shallow and usually easily reached.

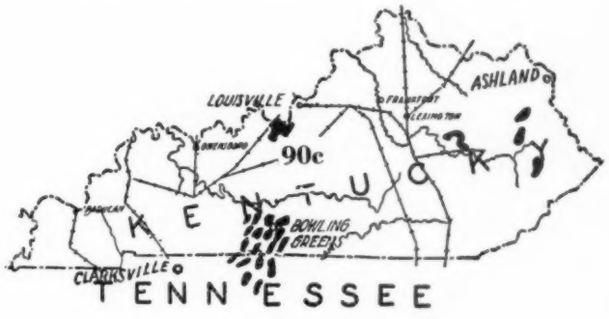


● Denotes oil and gas fields.

KENTUCKY

Production, 1930—7,300,000 Barrels

A total of 34 wells were completed in Kentucky last month, during which time there were 9 rigs and 70 drilling tests. Tennessee had 14 drilling wells, but no completions were made. Standard tools are used by operators in both states.



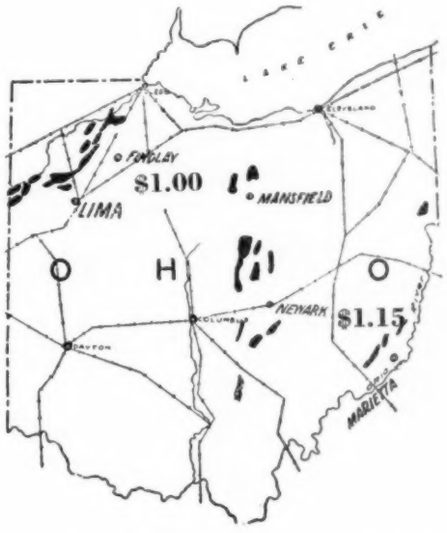
TENNESSEE

Production, 1930—20,000 Barrels

OHIO

Production, 1930—6,525,000 Barrels

Ohio had 125 completions last month, and 35 rigs and 141 drilling tests, the majority of which were in the central area. Cable tools are utilized for practically all drilling purposes in the state.



WEST VIRGINIA

Production, 1930—5,100,000 Barrels

West Virginia field operations consisted of 51 completions, 15 rigs and 40 drilling tests for the month of December. Drilling operations are conducted with cable tools.

Figures on maps indicate average prices of crude oil per bbl.

NEW MEXICO

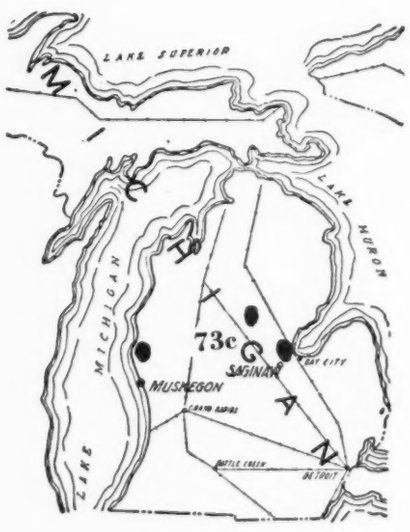
Production, 1930—10,235,000 Barrels

Activity in the state of New Mexico continues to decline. The last month of the year 1931 had but 2 completions, and field activity was comprised of 5 rigs and 53 drilling wells.

Both rotary and cable tools are used in the state, with the former predominating. Producing horizons in the southeast corner of the state, which is the most active and also the most promising, are comparatively deep and heavy upper gas pressures are frequently encountered, and heavy equipment is required to handle the conditions.

MICHIGAN

Production, 1930—3,525,000 Barrels

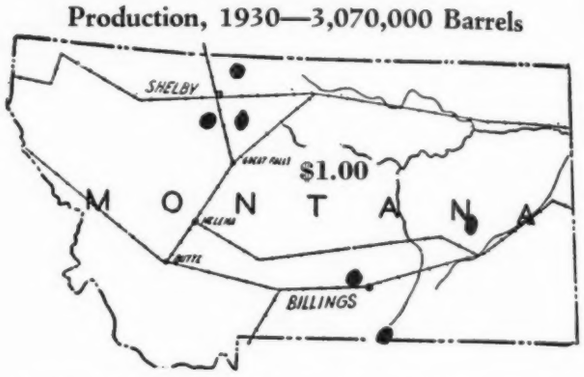


Fourteen wells were completed in Michigan during the month of December. Field activities showed a slight increase, there being 70 rigs and 87 drilling tests in the state at the end of the year.

Operators of the state do their drilling with cable tools, except in a few instances where rotary tools have been used.

MONTANA

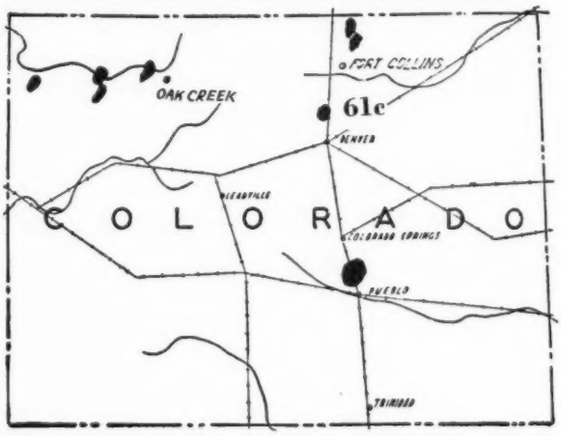
Production, 1930—3,070,000 Barrels



Montana had 30 completions, 19 rigs and 50 drilling tests last month. Cable tools are the most common means of drilling in the state.

COLORADO

Production, 1930—1,644,000 Barrels



Four completions were made in Colorado in December. Drilling activity for the month was comprised of 14 rigs and 72 drilling wells. Both rotary and cable tools are used in the state.

INDIANA

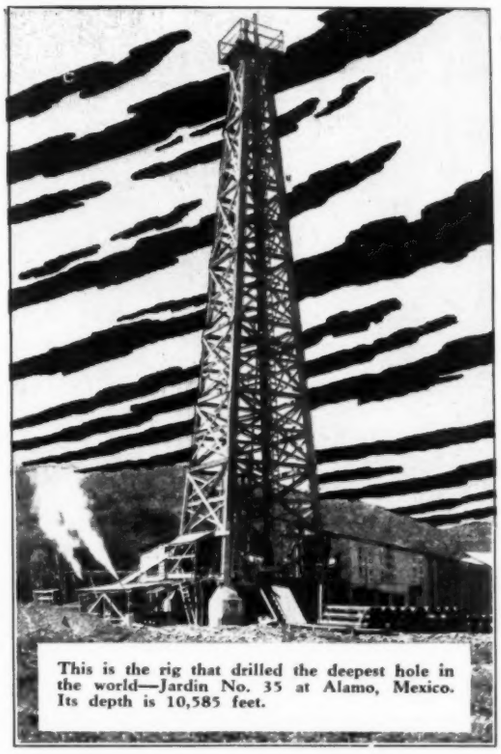
Production, 1930—1,000,000 Barrels

Indiana had 22 completions during the month of December, which is the highest number it has reached in many months. Other activity in the state consisted of 4 rigs and 60 drilling tests.

Producing horizons in the state are shallow and offer no perplexing drilling problems in reaching. Standard tools are used for drilling operations.

● Denotes oil and gas fields.

Figures on maps indicate average prices of crude oil per bbl.



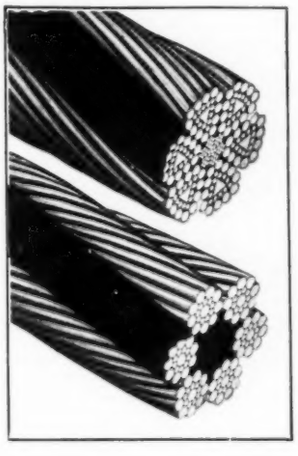
This is the rig that drilled the deepest hole in the world—Jardin No. 35 at Alamo, Mexico. Its depth is 10,585 feet.

A "Hercules" (Red Strand) Rotary Line Helps Drill the Deepest Hole in the World

And now a well two miles deep! That is the record recently established by the Penn Mex Fuel Company at their Jardin No. 35 test well at Alamo, Vera Cruz, Mexico.

In preparing for this record hole, the Penn Mex Fuel Company selected such equipment as they considered the most dependable and long-lasting, for replacements were both difficult and slow. A 1⅛-inch "HERCULES" (Red-Strand) Rotary Drilling Line was chosen.

We are proud of the service of "HERCULES" (Red-Strand) Rotary Line on this record making project, but it is the rule rather than the exception, for a "Hercules" line to be selected for the extra hard jobs—it is made for just such work.



"HERCULES" (Red-Strand) Rotary Lines are furnished in both Patent Flattened Strand and Round Strand constructions in order to meet all conditions. Why not find out by a trial just how dependable and economical these lines are? A copy of our Catalog OG17 will be mailed gladly to any one interested in better wire rope service.

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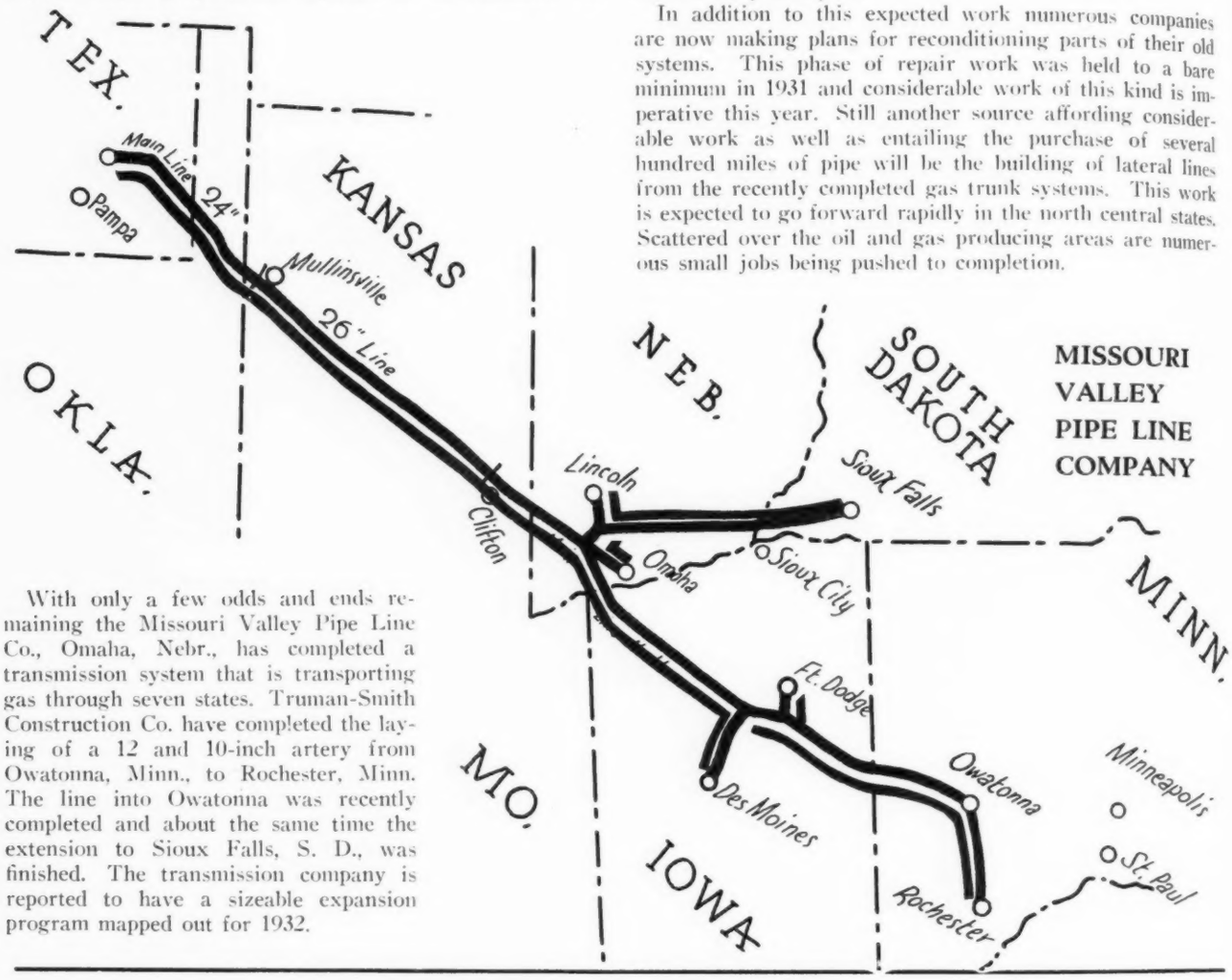
Progress of Major Pipe Line Work

By J. H. DAMERON

WITH pipe line construction at a low ebb, construction men are following with keen interest the developments in connection with the proposed 1932 projects. Several major projects are reported to be scheduled for 1932 and while no official announcement has been made concerning their construction reports continue to filter through the trade that some of the proposed work will be started early this year.

In addition to this expected work numerous companies are now making plans for reconditioning parts of their old systems. This phase of repair work was held to a bare minimum in 1931 and considerable work of this kind is imperative this year. Still another source affording considerable work as well as entailing the purchase of several hundred miles of pipe will be the building of lateral lines from the recently completed gas trunk systems. This work is expected to go forward rapidly in the north central states. Scattered over the oil and gas producing areas are numerous small jobs being pushed to completion.



With only a few odds and ends remaining the Missouri Valley Pipe Line Co., Omaha, Nebr., has completed a transmission system that is transporting gas through seven states. Truman-Smith Construction Co. have completed the laying of a 12 and 10-inch artery from Owatonna, Minn., to Rochester, Minn. The line into Owatonna was recently completed and about the same time the extension to Sioux Falls, S. D., was finished. The transmission company is reported to have a sizeable expansion program mapped out for 1932.

STANDARD OIL CO. OF CALIFORNIA

On the West Coast the Standard Oil of California is nearing completion of a 90-mile 8-inch line running from Kettleman Hills to Estero terminal on the Pacific Coast. The line is being built by company employes who otherwise would have been laid off during a slack period. The Gulf Pipe Line Co. is also doing a similar service to its employes on a 50-mile line in Oklahoma.

Indicates completed portion of line.
Indicates proposed route of line.

LINDEWELDING *lowers* THE BID *and gets* THE BUSINESS

A CONTRACTOR'S bid on a 60-mile section of 6-inch oil line was so low that the oil company investigated. They found that, because he used Lindewelding, he would save from 30 to 60 per cent. in welding time and 35 to 40 per cent. in welding material. Tests proved that Lindewelded joints were stronger than joints made by other methods. He got the job.

Lindewelding is a new method of oxy-acetylene welding. It can be done either with ordinary blowpipes or with special apparatus which makes welding almost automatic and further increases its speed. Experienced welders easily adapt themselves to Lindewelding, and beginners learn it readily.

Procedure Controls for Lindewelding are available to all users of Linde Oxygen. If lighter costs and faster work would mean lower bids and more contracts for your company, ask our nearest district office for complete information today.

Motion Picture Shows details of Lindewelding

Lindewelding technique differs from neutral flame welding technique in that it employs a special rod, a special flame adjustment, and the "backhand" method of blowpipe manipulation. The actual steps in making a Lindewelded joint are shown in our motion picture, "The Lindeweld Process for Pipe Line Construction." This picture will be loaned free of charge to pipe line officials and welding or engineering societies. It is furnished in 16 mm. and 35 mm. safety film and can be obtained by writing to any Linde District Office.

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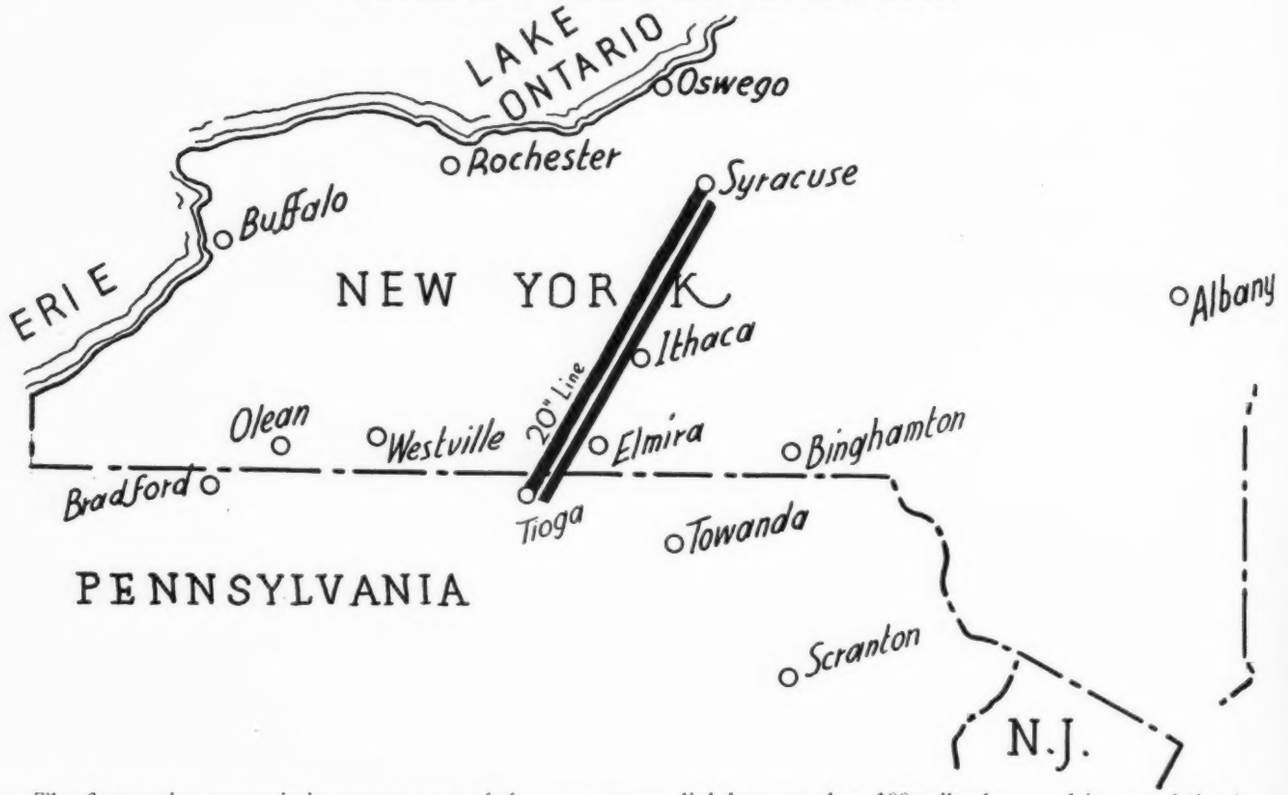
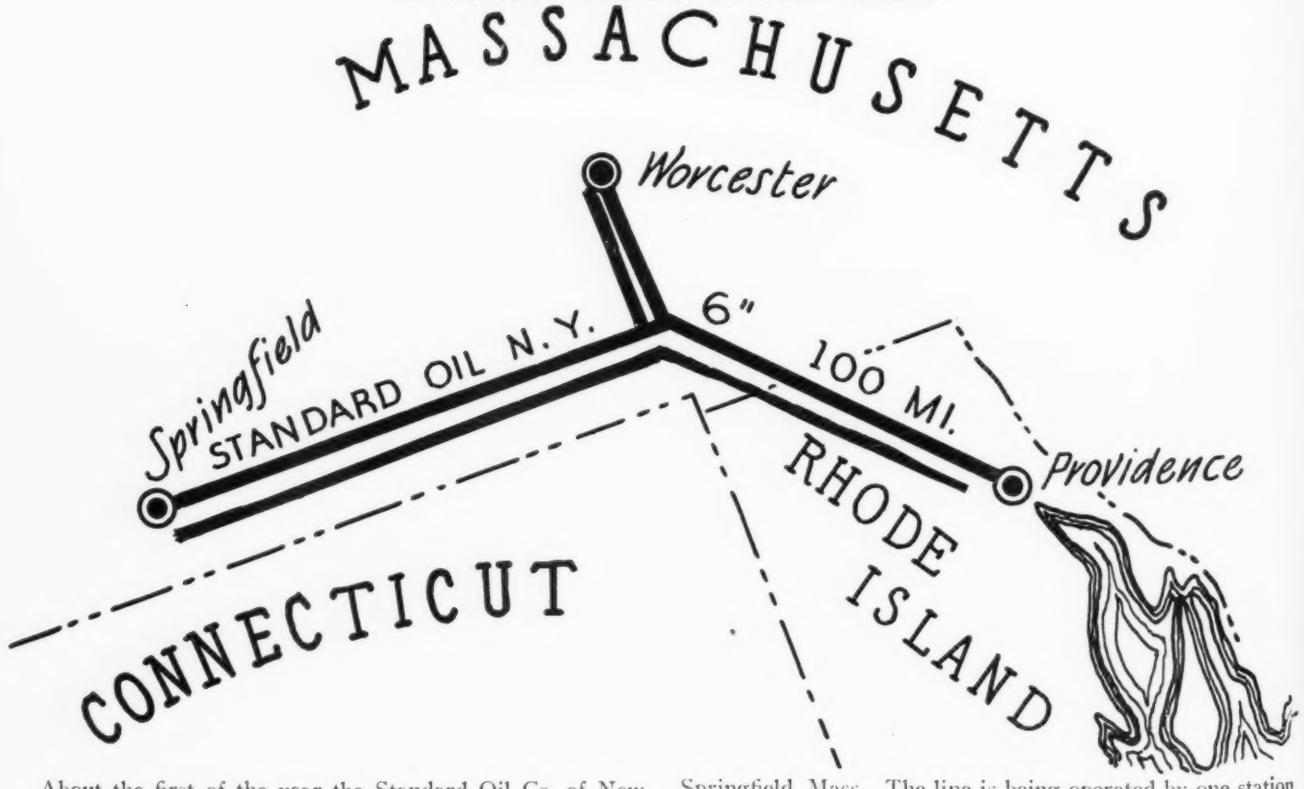
LYCOMING NATURAL GAS CORPORATION



The first major transmission system out of the comparatively new Tioga gas area is the Lycoming Natural Gas Corp.'s 20-inch line running to Syracuse. The line is slightly more than 100 miles long and its completion is expected about the middle of January. Gas is to be delivered to the distributing company operating in Syracuse.

STANDARD OIL CO. OF NEW YORK



About the first of the year the Standard Oil Co. of New York completed construction work on its 100 miles of welded 6-inch from East Providence, R. I., to Worcester and Springfield, Mass. The line is being operated by one station located at East Providence equipped with reciprocating pumps.

Indicates completed portion of line.
Indicates proposed route of line.

Sun Oil Co's. Gasoline Lines conquer difficult topography

THE Sun Oil Company's new gasoline lines, one extending from Marcus Hook, Pennsylvania, northward to Syracuse, New York, and the other from the same point westward via Pittsburgh to the Great Lakes, encountered their full share of difficulties of construction. Some of the country traversed is quite broken, very rugged and includes several river crossings, mainly, the Susquehanna and Allegheny, the latter being crossed four times. The elevations vary from near sea level at Marcus Hook, the Company's refining center, to almost 3,000 feet at Ligonier, Pennsylvania. When the pressure is 600 pounds at Chambersburg, it mounts to 900 pounds at Lovely Station, further west on the line.

So sound were the measures taken and so thorough the workmanship applied, that when the 57,000 welds in the line running west, were tested with water at 1,200 pounds pressure, not a single leak developed.

For the major part of this important enterprise the choice was NATIONAL Pipe. The confidence of engineers in NATIONAL for all such undertakings is sustained by abundant records of successful service in the most trying uses. Year by year it holds its place as—

America's Preferred Line Pipe

NATIONAL TUBE COMPANY, Pittsburgh, Pa.
Subsidiary of United States Steel Corporation

NATIONAL PIPE

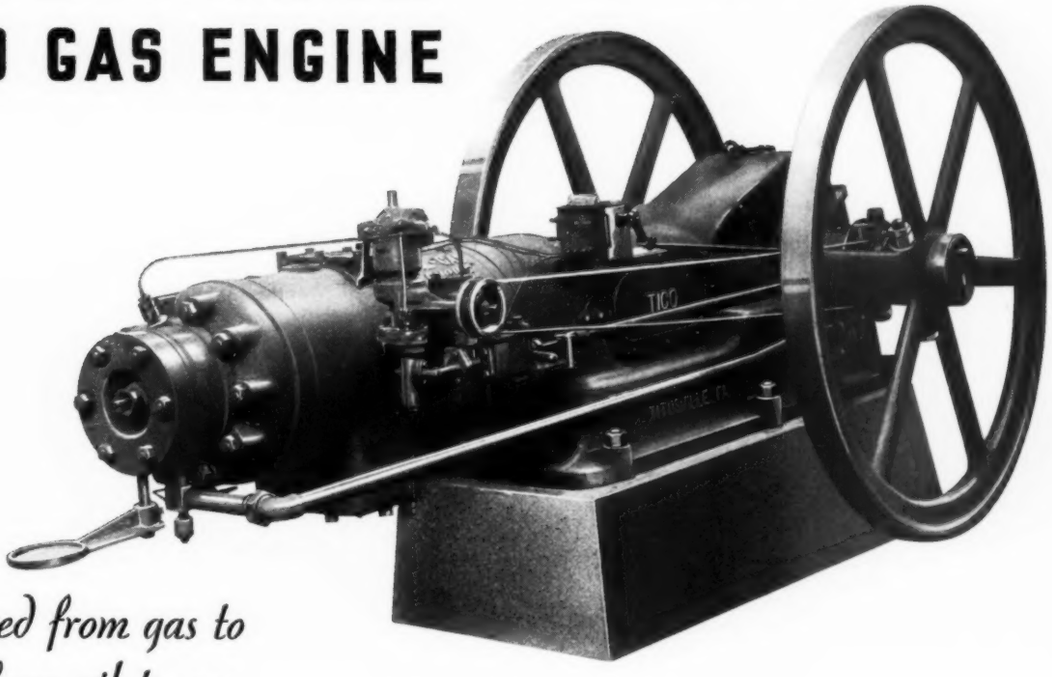
PIPE LINES UNDER CONSTRUCTION AND CONTEMPLATED

Type Line	Company Name	Headquarters	Point of Origin	Terminal	Size Pipe	Length in Miles	Remarks
O. L.	Ajax Pipe Line Co	Springfield, Mo.	Glenn Pool, Okla	Wood River, Ill	10"	400	Making plans to parallel existing 2-10" with third 10".
G. L.	Arkansas Valley P. L. Co	Colorado Springs, Colo	Central, Colo.	Various cities in Colo	6"	40	Making extensions of Colo. system.
Ga.L.	Atlantic Refg. Co.	Philadelphia, Pa.	Point Breeze	Wilkes-Barre, Pittsburgh	6-8"	475	Part of system operating, remainder about complete.
Ga.L.	Bivens, C. E., et al	Laramie, Wyo.	Baggs Field	Laramie, Wyo.	12"	104	Plan to build in 1932.
G. L.	Columbia Gas & Elec. Co	New York, N. Y	Ky. or Pan Eastern Line	Detroit, Mich.	20"	220	Considering going to Detroit, Mich., with line.
G. L.	Continental Constr. Corp	Chicago, Ill.	Chicago, Ill.	Detroit, Mich.	20"	200	Plan extension of Panhandle line to Detroit.
G. L.	Continental Constr. Corp	Chicago, Ill.	Point in Ill.	Milwaukee, Wis.	20"	160	Buying right of way.
G. L.	Continental Constr. Corp	Chicago, Ill.	Texas Panhandle	Chicago, Ill.	24"	1000	Plan to start parallel present line in 1932.
O. L.	Continental Oil Company	Ponca City, Okla	Greasewood Flats, Colo	Denver, Colo.	6"	70	Proposed—making cost survey.
O. L.	Continental Oil Company	Ponca City, Okla	Greasewood Flats, Colo	Hardin	4"	16	Completed 15-car rack at Hardin and one 5,000-bbl. tank.
O. L.	Cities Service, Insull, Texas Corp. & S. O. N. J.	(See Remarks)					Rumored considering building 1,500-mile project from Panhandle to Eastern cities.
Ga.L.	Great Lake Pipe Line Co	Kansas City, Mo	Okla. Midcontinent	Great Lakes Region	4-6-8"	1440	Plan to loop and add 3 units to each sta. or build automatic booster station.
O. L.	Gulf Pipe Line Co	Tulsa, Okla.	Tulsa, Okla.	Spencerville, Ohio	10"		Plan looping present line and increasing station capacity.
G. L.	Iroquois Gas Company	Buffalo, N. Y.	Wayne Field, N. Y.	Buffalo, N. Y.	8"	60	Completed.
G. L.	International Util. Corp.	New York, N. Y.	Alberta, Canada	Vancouver, B. C.	20"	500	Proposed.
G. L.	Jerome Drumheller	Spokane, Wash.	Cut Bank, Wyo.	Seattle, Wash.	20"	500	Proposed.
G. L.	Lycoming Nat. Gas. Corp.	New York, N. Y.	Tioga Field, N. Y.	Syracuse, N. Y.	20"	100	Resumed construction.
G. L.	Lewiston Nat. Gas Co.	Lewiston, Mont.	Armells Structure, Mont.	Mont. towns	4-6"	100	Proposed.
G. L.	Missouri Valley P. L. Co.	Omaha, Neb.	Point in Minnesota	Minneapolis, Minn.	16"		Proposed.
G. L.	Montana-Dakota Power Co.	Minneapolis, Minn.	Williams, N. D.	Minot, N. D.	12"	100	Applied to N. D. Commission for permission to build.
G. L.	Mo.-Kans. Pipe Line Co.	Chicago, Ill.	Russellville, Ky.	Nashville, Tenn.	10"	50	Proposed.
G. L.	Ohio Oil Company	Findlay, Ohio	Weiser Field, Idaho	Boise and Northwest area			Filed application for conveyance certificate.
G. L.	Pacific Gas & Elec. Co.	San Francisco, Calif.					Have appro. for $2,000,000 expansion campaign.
G. L.	Panhandle Eastern P. L. Co.	Kansas City, Mo.	(See Remarks)				Reported planning 200 miles of lateral line construction in Missouri and Illinois.
Ga.L.	Phillips Pipe Line Co.	Bartlesville, Okla.	Texas Panhandle	St. Louis, Mo.	8"		Plan to build 4 booster sta. and build 50 miles of line.
O. L.	Stanolind Pipe Line Co.	Tulsa, Okla.	Mid-Continent	Chicago, Ill.	8-10"	360	Looping 360 mi. of existing line and increasing station capacity, looping complete.
Ga.L.	Sun Pipe Line Company	Philadelphia, Pa.	Point in N. Y.	Lake Ontario	6"	45	Extending to tidewater terminal.
G. L.	Southern Nat. Gas Corp.	Birmingham, Ala.	(See Remarks)				Reported planning extension to Chattanooga, Tenn.
O. L.	Texas Empire Pipe Line Co.	Tulsa, Okla.	Okla. City, Okla.	East Texas	10-12"	250	Pur. right of way for oil line to East Texas pipe inquiry out.
O. L.	Tex-York Utilities Corp.	New Orleans, La.	East Texas	New Orleans, La.	8"	400	Proposed.
G. L.	United Public Service Co.	Houston, Texas	(See Remarks)		4-6-8"	100	Extending main line in S. Louisiana complete.
G. L.	United Public Service Co.	Houston, Texas	Austin	Wichita Falls	20"	240	Rumored plan extension of main line system.
Ga.L.	White Eagle Oil Co.	Augusta, Kan.	Augusta, Kan.	Kansas City, Mo.	8"		Considering construction of Gasoline line.
Ga.L.	Wasatch Gas Company	Ogden, Utah	Ogden, Utah	Pocatello, Idaho	10"	140	Applied for permit to build welded line.
O. L.	Yount-Lee Oil Company	Beaumont, Tex.	High Island	Spindle top	10"	45	Building oil outlet to Spindletop storage.
O. L.	Texas Royalty Owners & Producers P. L. Co.	Tyler, Texas	East Texas	Houston, Texas	12"	200	Applied to Texas "Blue Sky" Commissioner for permission to sell stock.

TABLE

O. L.—oil line Ga. L.—gasoline line
G. L.—gas line

THE TICO CONVERTIBLE OIL AND GAS ENGINE



can be changed from gas to oil fired, or from oil to gas, in two hours

The Tico Engine was designed and developed in its entirety by our own engineering department, without receiving any suggestions, assistance or designs from any other parties. The same men who designed this engine were quick to anticipate any possible improvements and have kept it fully abreast of modern drilling requirements. The reliable TICO Gas Engine, converted to oil, is an outstanding example of this Titusville leadership.

THE TITUSVILLE IRON WORKS CO.
Division of Struthers Wells-Titusville Corporation
TITUSVILLE, PENNA.

The Month's Activities *in* Refining*

By F. R. STALEY

THE Pratt vapor phase cracking unit in the Mobile, Ala., refinery of the Coastal Petroleum Corporation will start operating this month. It will operate on East Texas crude shipped by tank steamers and barges.

A new 4,000-barrel refinery in Japan started operations recently. It was built by the Associated Oil Company and the Mitsubishi Oil Company, Ltd. It consists of a combination topping and cracking unit and a lubricating oil unit. California crude will be processed. The plant is located on Tokyo Bay.

Black, Sivalls & Bryson have been awarded a contract for the construction of a gasoline stabilization unit in the Wichita Falls refinery for the Continental Oil Company.

The Wilcox Oil & Gas Company is planning to install a reforming unit in its refinery at Bristow, Okla.

A company has been organized in Norway to operate a refinery. The capacity will be about 1,000 barrels daily.

D. J. Moran, Continental Oil Company, vice-president of the A. P. I. Refinery Division, has announced the appointments to the various committees of this division:

K. G. Mackenzie, The Texas Company, is chairman of the Committee on Testing Methods and Specifications.

R. P. Anderson, American Petroleum Institute, is chairman of the Committee on Motor Fuel Research.

C. H. Haupt, Standard Oil Development Company, is chairman of the Committee on Fire Prevention in Refineries.

C. W. Smith, Standard Oil (Indiana), is chairman of the Committee on Accident Prevention in Refineries.

Walter Samans, Atlantic Refining Co., is chairman of the Committee on Corrosion of Refining Equipment.

John S. Hess, Sinclair Refining Co., is chairman of the Committee on Disposal of Refinery Wastes.

The American Society for Testing Materials has recently issued the 1931 Index to A. S. T. M. Standards and Tentative Standards. It is a very convenient reference in ascertaining whether or not the society has issued any standards on a specific subject. Copies are furnished free on request.

The Ethyl Gasoline Corporation has withdrawn the proposal for the use of lead in non-premium gasoline in the United States. A new Q fluid had been proposed last November for use in non-premium gasoline to have an octane number between 68 and 70.

The Magnolia Petroleum Corporation is making a number of improvements in its Fort Worth, Texas, refinery.

Natural Gasoline

The Arkansas Fuel Oil Co. is planning to build a plant in East Texas near Willow Springs.

The Humble Oil & Refining Co. may build additional plants in East Texas.

The new natural gasoline grading system became solely effective January 1. According to a report by the Technical Committee of the Natural Gasoline Association of America, it has been fairly established that the plant yield basis for the new grading system is economically sound for both buyer and seller; if anything, the plant yield ratio basis favors the purchaser. The vapor pressure specification is the predominant economic factor as far as supply is concerned.

George B. Murphy, of Universal Oil Products Company, will address the Chicago section of the American Institute of Chemical Engineers, Chicago, January 13, on the application of chemical engineering principles in cracking petroleum products for the production of anti-knock gasoline.

Figures in red show per cent refining capacity operated.

*All statistics as of January 1st.

EVERY sixth man employed in the J & L Seamless Tube Department is *your* man, as truly as though he were on your payroll. Five out of every six *make* J & L Seamless Pipe; the sixth man—*your* man—inspects it.

You'll find this sixth man making chemical tests of raw materials; analyzing the steel for chemical and physical properties; checking the bloom pickling; examining the seamless pipe; verifying the wall thickness; checking pitch and taper of threads; inspecting couplings; rechecking all previous inspections; testing hydrostatically, and finally going all over the finished job.

Every sixth man, *your* man, is always looking for trouble and flaws, so that you won't have to. He makes sure that rejections are made at the mill, and not in the field. He's one of the big reasons why oil men regard the "J & L" mark on pipe as a complete guarantee of uniform quality, dependable service and long-time satisfaction.

JONES & LAUGHLIN STEEL CORPORATION

AMERICAN IRON AND STEEL WORKS

JONES & LAUGHLIN BUILDING, PITTSBURGH, PENNSYLVANIA

Manufacturers of Seamless and Welded Casing, Tubing, Drill Pipe and Line Pipe, and Welded Steam, Gas and Water Pipe in both Black and Galvanized

Also makers of Bars, Shapes and Plates, Reinforcing Bars, Cold Finished Steel, Junior Beams, Steel Piling, Fabricated Structural Work, Steel Barges, Wire Products and Tin Mill Products

J&L STEEL

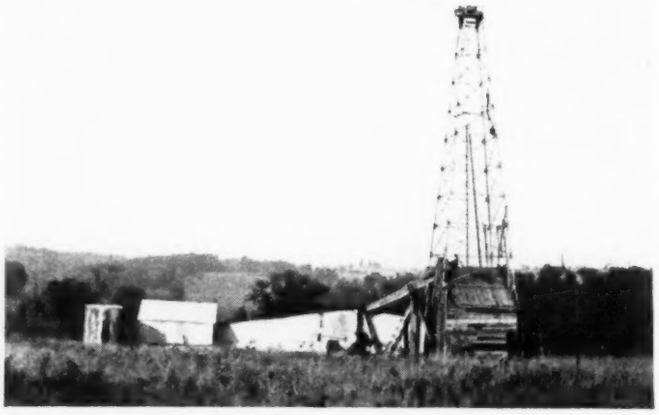
High Pressure Gas Used in
Recovering "Stuck" Drilling Tools

By F. B. MOORE[1] and E. V. O'ROURKE[2]

CONTRACTORS and drillers of oil and gas wells are confronted with many perplexing problems which occur during drilling, among which the "fishing job" or recovery of stuck tools causes a great deal of grief.

The process of retrieving cable-drilling tools requires patience and ingenuity. High pressure gas is not ordinarily used as an aid in "fishing", but in the case described in this article it was a matter of taking advantage of all facilities offered.

Fred Moore and Sons, contractors, during the drilling of a hole for the Emerald Oil Company in Perry Township, Coshocton County, Ohio, had the ill-luck of the wire line breaking when the drill was at a depth of three hundred and seventy feet. The break occurred a few feet above the splice, which connected the wire line and manila cable. The regular set-up of tools—rope-socket, jars, stem, bit and one hundred and twenty-five feet of manila cable were left in the hole. Drilling was being done in an open hole, with the exception of thirty feet of drive pipe. Porous water-bearing strata had been encountered at one hundred and sixty feet and water flowed freely into the hole. At the time of the drilling mishap, the head of water was more than one hundred feet. The drill had been churning the Injun or Blackhand Sand of the Mississippian Series at twenty feet in from the beginning of the formation, a sand that settles rapidly after being drilled through, and lost tools are stuck as if cemented. Eight to ten feet of the sand settled around the bit and box of the stem in this instance. Methods usually resorted to in recovering stuck tools in settling sands are either flooding or "drilling by the tools." Flooding is accomplished by running a string of casing down over the tools, and creating a suction by the use of a swab inside the casing. The sucking action of the swab causes circulation of the sand around the tools which is carried to the surface with the water. The other method, known as "drilling by" consists of drilling a hole alongside the stuck tools, using a reamer bit.



(Above) F. W. Moore (right), contractor, and Willard Murphy, lease operator. (Below) The J. W. Mossholder farm on which the well was drilled.

The prosecution of this fishing job started with the successful removal of the manila cable by the use of the rope knife and center spear. Preparations were then made for "flooding"; an eight-inch casing was run into the hole and a swabbing action was started and continued for a period of six hours. The result was unsatisfactory; a very small amount of the sand came out with the water.

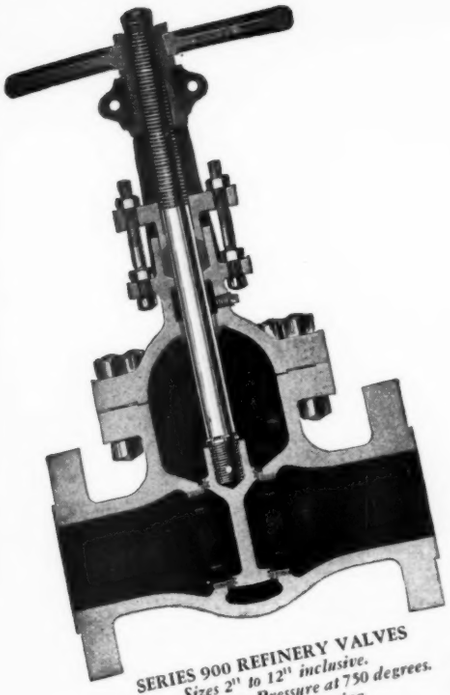
After several unsuccessful attempts by flooding, the other method known as "drilling by" was tried. The six-inch "tools" with the bit made into a reamer were used to drill a hole supposedly to the bottom of the stuck "string." By running an eight-inch slip socket a good hold was obtained on the rope socket of the lodged tools. After several hours of jarring and putting the equipment to a maximum strain, the hold broke. Several more holds were taken, but the tools still remained tightly enclosed by the sand. The flooding method was tried again without success.

A gas well with a rock pressure of from 800-1000 pounds per square inch was situated about one-quarter of a mile from the drilling location. At the suggestion of Fred Moore a two-inch line was laid from the gas well and run down to the bottom of the drilling hole. By an improvised method the pipe could be raised or lowered. The pipe was left suspended six inches off bottom so that there would be no resistance to the gas pressure. Upon opening the gate valve at the well, mud, water, and sand were thrown out of the hole. After the gas energy had been expended, the drillers were able to lower the pipe one foot. The process of blowing with gas was repeated eight times, with the gate at the gas well open for a minute each time, and intervals of forty-five minutes to an hour allowed the gas well to regain maximum rock pressure. After each trial the pipe was lowered from six to twelve inches.

Immediately after the operations described above, the two-inch tubing was pulled out and the tools were strung up. A ten-inch slip socket was used and no difficulty was encountered in obtaining a fast hold on the "lost tools." The cable was put under an upward strain and gave evidence of moving, it was unnecessary to use a jarring action. On "backing down," the tools dropped back. The cable was lifted in this manner several times, tending to loosen the tools from the sand. In fifteen minutes after the hold had been secured the lost tools were completely freed and drawn from the hole.

The writers believe that similar fishing jobs could be carried on successfully by the use of compressed air furnished from a portable compressor, in case a high gas pressure was not available.

[1] Fred Moore & Sons, Drilling Contractors.
[2] Professor of Petroleum Engineering, Ohio State University.



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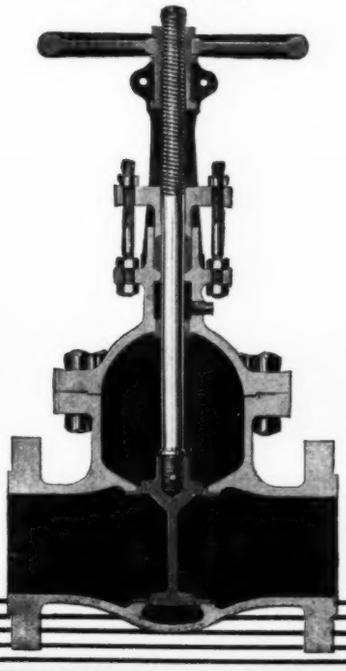
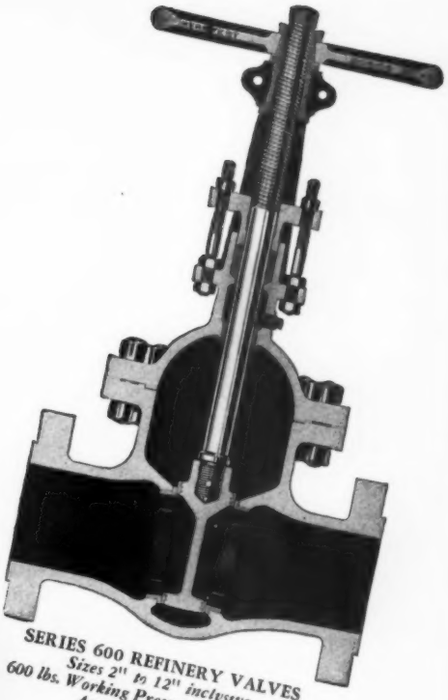
Sizes 2" to 12" inclusive.
900 lbs. Working Pressure at 750 degrees.
Any class of trimming.

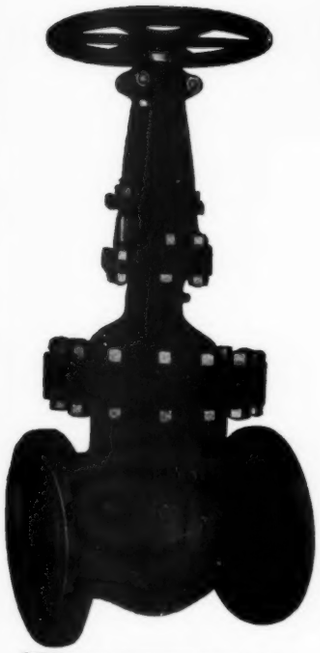
SERIES 400 REFINERY VALVES
Sizes 2" to 12" inclusive.
400 lbs. Working Pressure at 750 degrees.
Any class of trimming.





SERIES 600 REFINERY VALVES
Sizes 2" to 12" inclusive.
600 lbs. Working Pressure at 750 degrees.
Any class of trimming.

REFINERY VALVES



SERIES 300 REFINERY VALVES
Sizes 2" to 12" inclusive.
309 lbs. S. W. P. at 750 degrees.
Test Pressure 1000 lbs.

Whatever the service, pressure or temperature condition, you can depend on Kerotest to serve you and serve you well.

You will find in Kerotest, a complete line of refinery valves embodying the finest engineering practice—the perfected result of years of experience in meeting the most exacting requirements of oil and steam at high pressures and temperatures.

Kerotest Manufacturing Company
PITTSBURGH, PA.

ASK FOR COPY OF THE
COMPLETE KEROTEST CATALOG

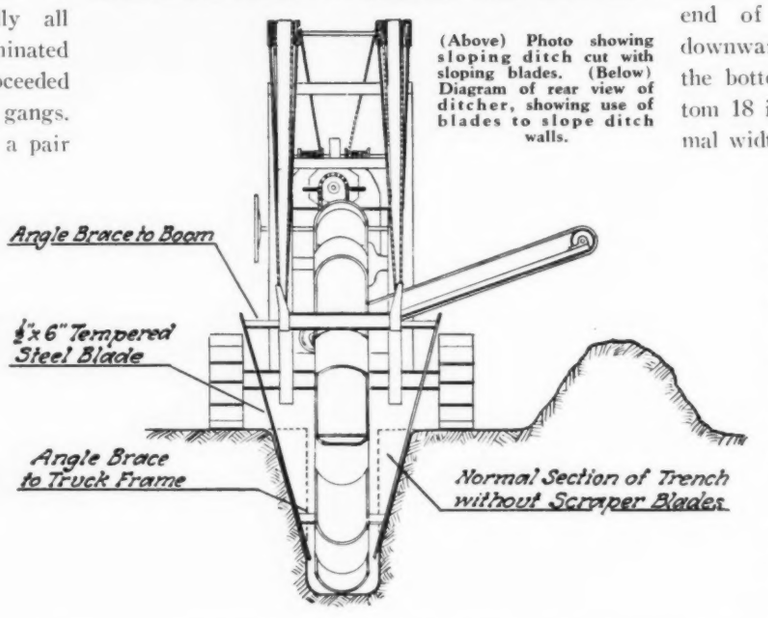
SERIES 150 REFINERY VALVES
Sizes 2" to 12" inclusive.
150 lbs. S. W. P. at 750 degrees.
Test Pressure 500 lbs.

Device Cuts Sloping Trench to Avoid Caving Troubles

CAVING ditches are perhaps one of the greatest time consumers in pipe line construction. This type of trouble often crops out in unexpected places for a mile or so through various sections of the country. Whenever it is encountered it usually causes delay and added expense, especially if the construction spread's gangs are working close together.

To minimize delays under such conditions, Williams Bros., Inc., Tulsa, Okla., pipe line contractors, have devised an attachment for their ditching machines to cut sloping ditches. With this device attached to the machine a trench normally 32 inches wide from top to bottom, is cut to a width of 60 inches and 32 inches at the bottom. By cutting the sloping ditch through stretches of country where the ground caved, practically all caving troubles were eliminated and construction proceeded without a "tie-up" of any gangs.

The device consists of a pair of cutter blades attached to either side of the digging wheel frame on the wheel type ditchers. They are set so they will cut a trench with a slope of about two to one. The bottom of the blades are set comparatively close to the wheel frame and several inches up from the bottom of the ditch.


Angle Brace to Boom
½"x 6" Tempered Steel Blade
Angle Brace to Truck Frame
Normal Section of Trench without Scraper Blades

(Above) Photo showing sloping ditch cut with sloping blades. (Below) Diagram of rear view of ditcher, showing use of blades to slope ditch walls.

When the cutter blades are attached the machine is consequently slowed down. This permits the buckets to handle the additional dirt pulled down from the side walls. The slower movement of the machine also reduces the stresses imposed on the braces holding the blades rigidly. Usually the machine's conveyor is extended to keep the spoil bank farther out from the edge of the trench.

The blades are made from lengths of a high quality tempered steel six inches wide and about half an inch thick. They are cut to the desired length for the particular job and the cutting edge is ground down to make cutting easier. Four-inch angle iron is used to brace the blades and attach them to the wheel frame. At the top the long cross member is bolted to the blades at one end and to the first cross member on the forward end of the wheel frame. The bottom is similarly braced. At the top the attachment is further braced by an angle brace going back to a cross member on the rear end of the wheel frame.

On a recent job in Illinois the contractors encountered caving trouble while ditching through bottom land. At the time the machine was digging a ditch 66 inches deep and 32 inches wide. Blades were attached and set at angle so the top width of the ditch was 60 inches. The bottom end of the blades extended downward within 18 inches of the bottom, permitting the bottom 18 inches to be cut at normal width by the digging wheel.

Ordinarily this auxiliary equipment or necessary material for its construction is carried in stock at the nearest base for spare parts. This permits its being tracked to the job a few hours after it is ordered.

The method was first used several year ago when one of the first big gas lines was being laid through rice fields. The sloping ditch minimized most of the caving troubles, but it was frequently necessary to throw the spoils on both sides of the ditch and pump the water out of the ditches.

Such an attachment is not practical to use except where the ground is soft and the digging easy. Even under such conditions the bolts holding the bracing members are sometimes sheared off. But for the short cuts through caving ground the attachment has saved the contractors considerable delay.

Wound-rotor motor, Type MTO, with two adjustable speeds, available in ratings of 35/15, 50/20, 55/25, and 75/35 hp., 440 volts, 50 or 60 cycles—suitable for belt or direct drive

ONE MOTOR

- - *for Every Power Operation*

HERE'S a motor that can be used with every type of rig for a producing well. On the pumping connection, the number of strokes per minute can be adjusted to meet the exact requirements of each well, without changes in gears or pulleys. ¶In any pulling operation, the torque, speed, and acceleration are all under the control of the operator. This feature facilitates "spotting" the load and avoids unnecessarily heavy starting current and mechanical shocks. ¶The high torque (425 per cent, or more, of full-load torque) and unusually high thermal capacity permit overload performance far in excess of that available with other types of drives. Type MTO motors with unit control are available through G-E warehouses located near your operations.

GENERAL ELECTRIC also furnishes complete electric equipment to meet every pumping and drilling requirement of the oil fields—including such new G-E developments as automatic weight control and direct-current drive for rotary drilling.

A nearby G-E office will be glad to supply complete information on any oil-field power application.

700-498

GENERAL ELECTRIC

SALES AND ENGINEERING SERVICE IN PRINCIPAL CITIES

New Natural Gasoline Specifications Now Effective

THE Natural Gasoline Association of America's new grading system became solely effective January 1. The description shown below includes all the specifications which apply to natural gasoline.

Natural gasoline is a liquid petroleum product consisting of the heavy hydrocarbons extracted from natural gas by such means as compression, absorption and other processes.

Natural gasoline is defined further for commercial purposes by the following specifications:

1. Vapor pressure—10 to 34 pounds per square inch absolute at 100 degrees F. (Reid).
2. Percentage evaporated at 140 degrees F.—25 to 85.
3. Percentage evaporated at 275 degrees F.—not less than 90.
4. End point—not higher than 375 degrees F.
5. Corrosion—non-corrosive.
6. Doctor test—negative, "sweet."
7. Color—not less than +25 (Saybolt).

In addition to the above general specifications, natural gasoline shall be divided into twenty-four possible grades on a basis of vapor pressure and percentage evaporated at 140 degrees F. Each grade shall have a vapor pressure range of 4 pounds and a range of 15 per cent in percentage evaporated at 140 degrees F. The maximum vapor pressure of the various grades shall be 14, 18, 22, 26, 30 and 34 pounds, respectively. The minimum per cent evaporated at 140 degrees F. shall be 25, 40, 55 and 70, respectively. Each grade shall be designated by its maximum vapor pressure and its minimum per cent evaporated at 140 degrees F., as shown in the accompanying table.

The A. S. T. M. distillation point of 140 degrees F. applies to barometric pressures of 740 mm. For other barometric pressures, the temperatures shown in the following table must be used instead of 140 degrees F.:

754 mm.	141° F.	669 mm.	135° F.
740 mm.	140° F.	655 mm.	134° F.
726 mm.	139° F.	641 mm.	133° F.
712 mm.	138° F.	626 mm.	132° F.
697 mm.	137° F.	612 mm.	131° F.
683 mm.	136° F.	598 mm.	130° F.

Additional corrections shall be applied at the rate of one degree at 14.5 mm.

Minor Revisions in Other Specifications

In addition to the changes in volatility specifications described in the preceding paragraphs, several minor changes have been made, as follows:

(1) An omnibus requirement has been included, stating that the A. S. T. M. per cent evaporated at 275 degrees F. shall be not less than 90.

(2) The doctor test as applied to natural gasoline has been standardized.

Grades of Natural Gasoline

Percentage Evaporated at 140° F.

Vapor Pressure, Lbs. Per Sq. In. Abs., at 100° F. (Reid)	25	40	55	70	85
34	Grade 34-25	Grade 34-40	Grade 34-55	Grade 34-70	
30	Grade 30-25	Grade 30-40	Grade 30-55	Grade 30-70	
26	Grade 26-25	Grade 26-40	Grade 26-55	Grade 26-70	
22	Grade 22-25	Grade 22-40	Grade 22-55	Grade 22-70	
18	Grade 18-25	Grade 18-40	Grade 18-55	Grade 18-70	
14	Grade 14-25	Grade 14-40	Grade 14-55	Grade 14-70	
10					

Although the complete economic effects of the new natural gasoline grading system can only be determined by actual use of the specifications in the channels of trade, the only uncertain factors in the equation are the ones bearing on demand in relation to grade. The supply factors have been rather thoroughly analyzed and can be simply stated.

The vapor pressure specification in the new grading system is the essential economic element. On this specification depend plant yields and the uses to which the product can be put. The sole effective function of the distillation specification is to provide a barrier against abnormal products or to provide a key to physical properties.

Those describable factors in anti-knock ratings not adequately defined by octane numbers, such as lead responsiveness and maintenance of anti-knock values over wide operating ranges, are all in favor of natural gasoline.

An approximate rule for finding octane number of natural gasoline is 54 plus the vapor pressure; for example, the octane number of the 26-70 grade is 80.

Some of the outstanding work of the Natural Gasoline Association of America carried on during the past year is outlined below:

The residue gas curve was reviewed and reaffirmed. The accuracy of the original curve was proved.

The Standard Casinghead Gas Contract Form is now universally used in the industry. An amendment to the Standard form was prepared so that it is now acceptable to the Department of the Interior for use involving public and Indian lands.

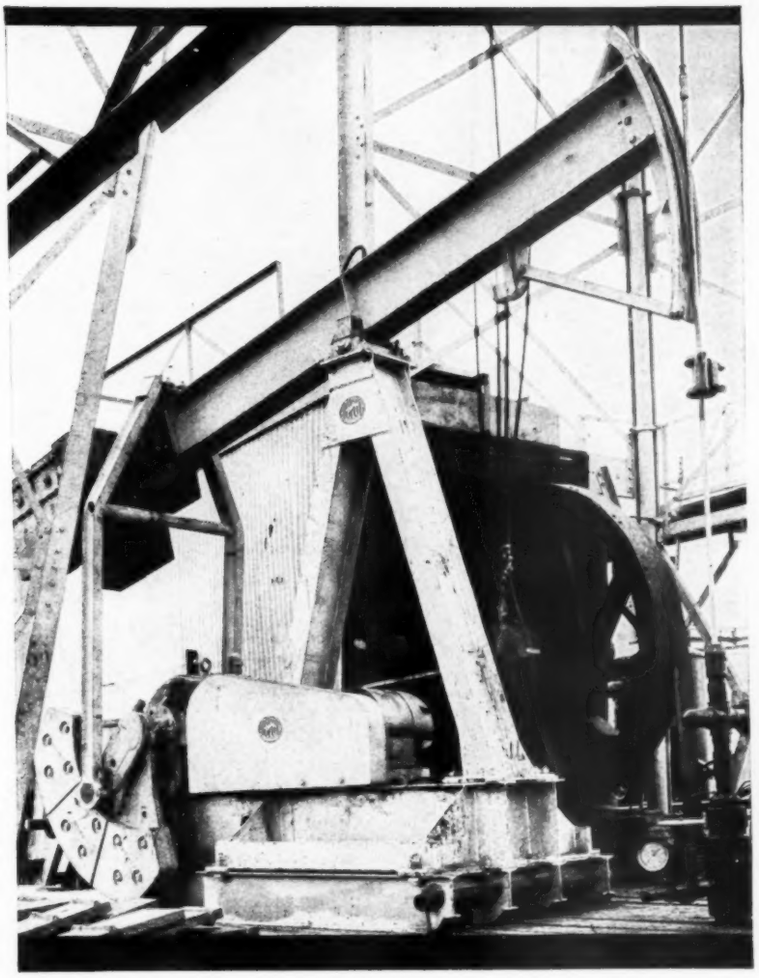
Standard forms were prepared for inter-company accounting. The Standardization Committee has about completed work on the standardization of storage tanks for natural gasoline. A report on production costs in various size and type plants will be released shortly. It is a result of exhaustive study by the Economics Committee.

The Gas Testing Committee revised the testing codes for testing natural gas for gasoline content. The oil absorption method was dropped. The American Gas Association has been asked for its continued approval. A mode for using the Reid Vapor Pressure Method accurately was prepared and accepted by the Bureau of Standards and the A. S. T. M. Minor revision of the Method of Distillation Natural Gasoline was made and approved by the A. S. T. M.

The Liquefied Gas Committee completed specifications for propane, butane, and pentane. The Technical Committee has prepared a pamphlet on blending information.

Exhaustive research work by the Technical Committee will be started soon to study vapor locking tendency in actual road service. Tests will be run during all seasons of the year, on numerous types of cars.

HOLD DOWN PRODUCTION COSTS WITH IDECO PUMPING UNITS



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- Penstocks

PROFITS DEPEND UPON LOWERED PRODUCTION COSTS---MORE TODAY THAN EVER BEFORE

Obsolete equipment can't be tolerated in these days when "the survival of the fittest" ceases to be an interesting theory and becomes a *stern reality*. Profits are to be made — worth-while profits — in the oil industry, as in other industries, but only by those equipped to produce on an economically sound basis. Only when oil is lifted economically can it be lifted profitably. Today out-of-date pumping equipment means "out-of-the-running" where profit is concerned. IDECO A-3 Pumping units are built to meet conditions requiring lowered production costs. It will pay you, as it has done others, to investigate the advantages of this new pumping unit.—Write or wire for further information.

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Branches and Stocks in every active oil field

Paint Is a Valuable Oil-Well Equipment Protection

WIDESPREAD application of paint coatings to equipment is an important oil field development of the past few years. The outstanding recent advancement in the use of this protective commodity has been the adoption by several oil companies of a practice of coating almost all producing equipment. Metal surfaces, such as stock and storage tanks, have been painted for a number of years, but application of paint material to actual producing equipment; for example, pumping jacks, well-head flow connections, separators, etc., is a comparatively new practice.

Manufacturers ordinarily paint this type of equipment when made, but few operating companies have heretofore made any effort to keep these materials coated. Painting above-ground well-head connections, jacks, etc., has been found to have a preserving effect, as it prevents rust caused by exposure to weather conditions, oftentimes retards corrosion from chemicals in the oil and in addition gives a neat, clean appearance to the property.

It has only been in the last few years that corrosion from weather elements has been given a great deal of thought by oil men. It is a matter of common observation that a piece of iron or steel placed so that it is sometimes in water and sometimes in the air rusts somewhat rapidly, but if this piece of equipment is covered with paint, or any other water-resistant substance, the rusting will be much slower. Rusty gate-valves have been common in practically all oil fields, and such conditions have been detrimental to a long serviceable life. The same conditions apply to pumping jacks, separators and particularly to any equipment through which crude oil passes.

Corrosion to producing equipment caused by chemicals in the oil is a most frequent occurrence on the inside of gate-valves, pipes, etc. This soon promotes leaky connections which initiate corrosion from the exterior, and greatly increases the speed of its destructive work; an action that can largely be overcome by paint coatings.

In choosing paints for oil field use many factors are to be considered, the most important are cost and protective value. There are many companies now using a standard color for all materials and these concerns have been able to reduce the initial cost of paints by buying in large quantities. The cost of paints becomes practically a negative factor when it is considered that approximately three-fourths of a paint job cost is usually labor and that a large part of the investment may be sacrificed by an attempt to save a few cents on materials per gallon of paint, thereby obtaining cheap auxiliary pigments for mixing with good paints which gives an inferior painting job.

There are several requirements for a good protective paint in the oil fields, as it is subject to contact with many different chemical elements. Different paints are naturally required for different applications, and it is best to consult someone familiar with paint qualifications before choosing a particular type of paint.

Application of paint coatings in the field is different from shop work, in that shop work usually consists of painting new materials that are free from rust and corrosion. The best paint is not foolproof. Any good grade, well applied onto a clean surface will outlast the best paint carelessly applied to a dirty or rusty surface.

Cleaning is done in several ways. The most common is by steel scrapers, which do a good job on smooth and easily accessible surfaces, but special scrapers and chisels are needed to clean bolt heads and other similar places. Excellent cleaning on fairly accessible surfaces may be done at reasonable cost by means of power-driven rotary steel brushes. Sand-blasting is a highly effective means, particularly when doing the work in shop and the proper equipment may be installed. Another means of cleaning is the boiling of equipment in special cleaning chemicals, many of which are highly effective.

Colors in use in the oil fields are of various shades, many companies using dark colors, which prevent staining by oils, etc., other common colors are gray and aluminum, both of which give an unusually neat appearance and help to limit evaporation by reducing the temperature from rays of the sun.

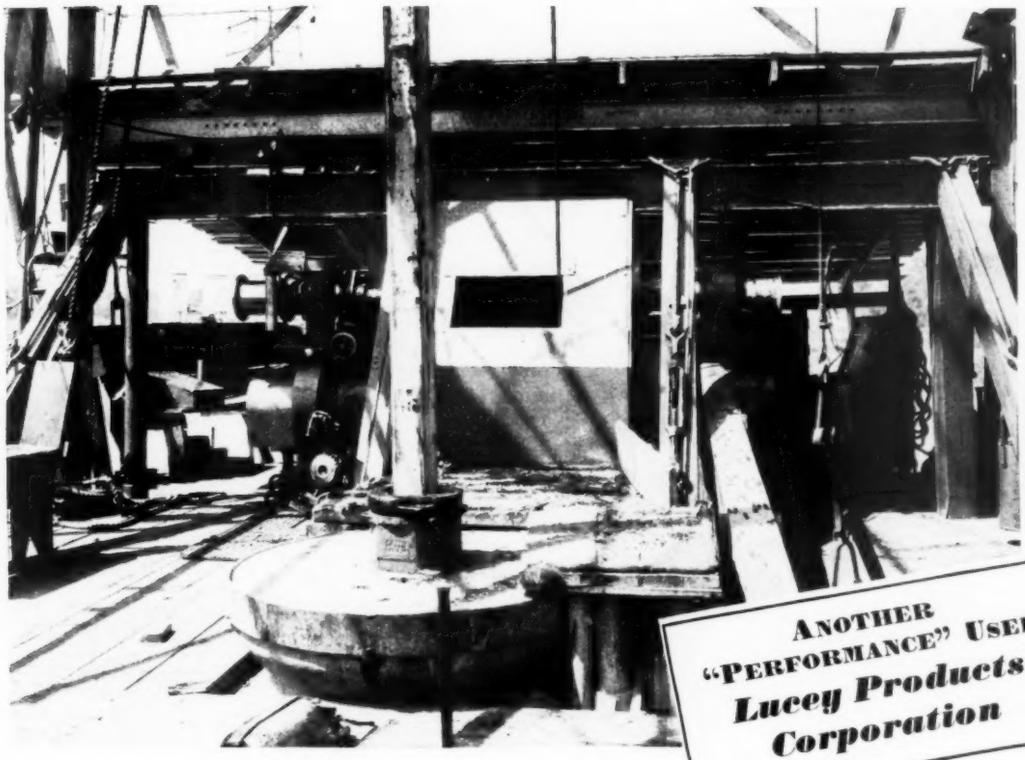
If a surface is to be given two coats, as most frequently is the case, and the second coat is of the same color as the first one, it is not easy to be sure that the second coat is applied perfectly over the first. To reduce the possibilities of missing spots the two coats are commonly of a little different color.

A very outstanding example of the use of paint on well equipment is in the Van Pool of Van Zandt County, Texas. This field is on unitized acreage operated under the supervision of the Pure Oil Company. All derricks, well connections, separators, lease tanks and other equipment are coated with a light gray paint. Since the entire field is under the direction of one company all wells are alike in equipment and coloring, with the effect that an unusual picture of neatness and care is given the observer.

Paint coatings to equipment are being applied not only in the new fields, but in many of the older producing areas. Many district foremen are keeping old producing properties in a neat and clean condition through application of paint to old equipment.

A neat, well-painted lease tank battery.

PERFORMANCE OF SKF BEARINGS MAKES OIL HISTORY!



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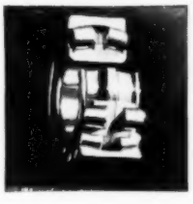

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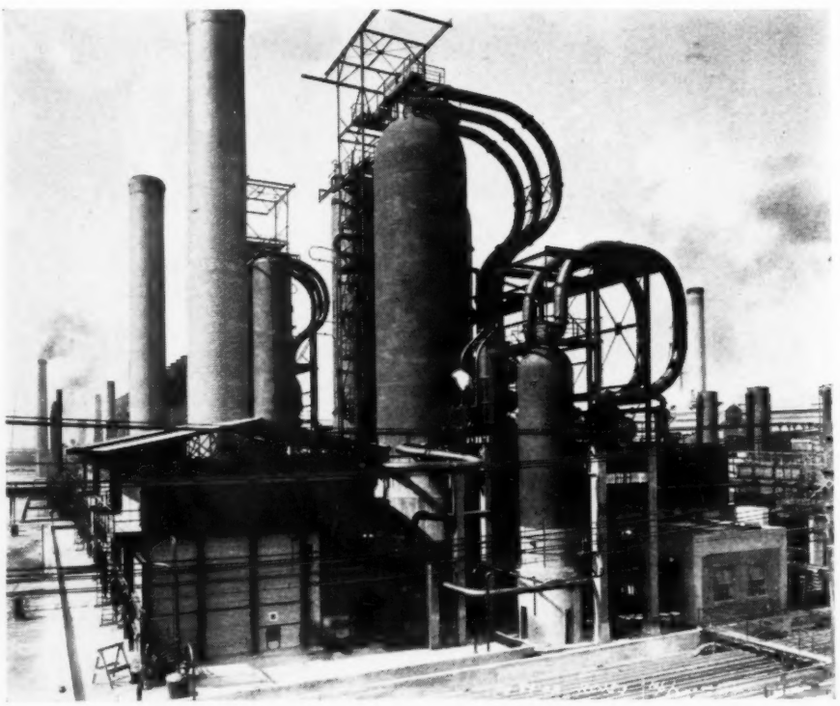
PROGRESS IN FRACTIONAL

THE last year has seen many improvements in the design of petroleum distillation equipment. The tendency has been toward larger units and higher efficiencies. Large units are generally more economical than smaller ones, due to the decreased number of parts for a given quantity of finished product and lower operating charges.

Modern distillation units can be run for long periods without necessity of shut downs for maintenance or inspection. This is an important feature in making the larger units economical, since frequent shut downs would make outage losses prohibitive. Properly designed units are arranged so that heat exchangers may be by-passed to permit cleaning without shutting down the entire equipment, the heat exchanger being the only portion of the complete distillation unit which need be overhauled frequently.

As far as is known the largest crude distillation units running to high grade lube stocks including overhead cylinder stock are the two 14,000 - barrel - per-day two-stage units in a large Southern refinery. These two units consist of atmospheric and vacuum stages, each complete with its own tube still, tower, heat exchanger and pumping equipment. In addition to the ordinary vacuum stage is a vacuum flash jug which processes the bottoms received from the large vacuum tower. A maximum yield of overhead cylinder stock is thus produced under a higher vacuum than could be obtained in the lower section of the vacuum tower.



Two-stage distillation unit showing vacuum flash jug in the foreground. This unit charges 14,000 barrels of crude per day, which is run to eight different fractions, including overhead cylinder stock. A duplicate unit is just beyond the unit in the foreground. The two units are placed together on a plot 140x220 feet. The compactness of these units is a striking contrast to the old fashioned shell still batteries, some of which were a mile in length.

The entire crude charge of each unit is pumped through heat exchangers in the overhead vapor line from the atmospheric stage, the overhead vapor and wax distillate lines from the vacuum stage. After being preheated the crude enters the atmospheric tube still and flows first through the convection section and then through the radiant heat absorbing tubes in the roof of the still. The oil is heated to a temperature of about 600 degrees F. before being discharged into the flash chamber at the bottom of the atmospheric tower. The tube still is fitted with a superheater which heats exhaust steam for process work in the tower. Most of this steam is delivered to the gas oil reservoir at the bottom; the balance is used at the various internal stripping sections. The atmospheric tower fractionates the crude charge into gasoline, naphtha, kerosene and light gas oil.

The residuum consisting of heavier fractions is taken from the atmospheric tower by hot oil pumps and delivered to the vacuum tube still. The vacuum tube still increases the temperature from about 500 degrees F. to 780 or 800 degrees F. before the reduced crude is discharged into the vaporizing chamber at the bottom of the vacuum tower. The vacuum tube still, like the atmospheric tube still, is equipped with a superheater in which exhaust steam for process work within the vacuum tower is superheated. The vacuum tower fractionates the reduced crude from the atmospheric stage into gas oil, wax distillate, heavy wax distillate and overhead cylinder stock. The vacuum stage is equipped with heat exchangers and final coolers of the shell and tube type. Vacuum for this tower is maintained by steam jet air pumps for the removal of non - condensable vapors and a barometric condenser for the condensing of steam used for process within the tower.

The vacuum equipment must necessarily be placed on the overhead vapor line at the top of the tower in order to make the vapors flow upward through the series of bubble trays within the tower, — vacuum balance lines are, of course, placed between vacuum rundown tanks and the vacuum system. It is obvious that the absolute pressure at the bottom of the tower is considerably higher than the pressure prevailing at the top due to the pressure loss through each bubble tray. On the other hand, to get the maximum yield of overhead cylinder stock, maximum vacuum must be obtained at the bottom of the tower. To overcome these inherent difficulties a vacuum flash jug is provided for receiving bottoms from the vacuum tower.

This flash jug is connected directly to the vacuum actuating system so that it operates under the highest vacuum which can be obtained with the cooling water available. Thus a considerable increase in yield of overhead cylinder stock is obtained without additional heating and with a minimum amount of process steam. The saving is twofold, inasmuch as a tower which would provide the same total

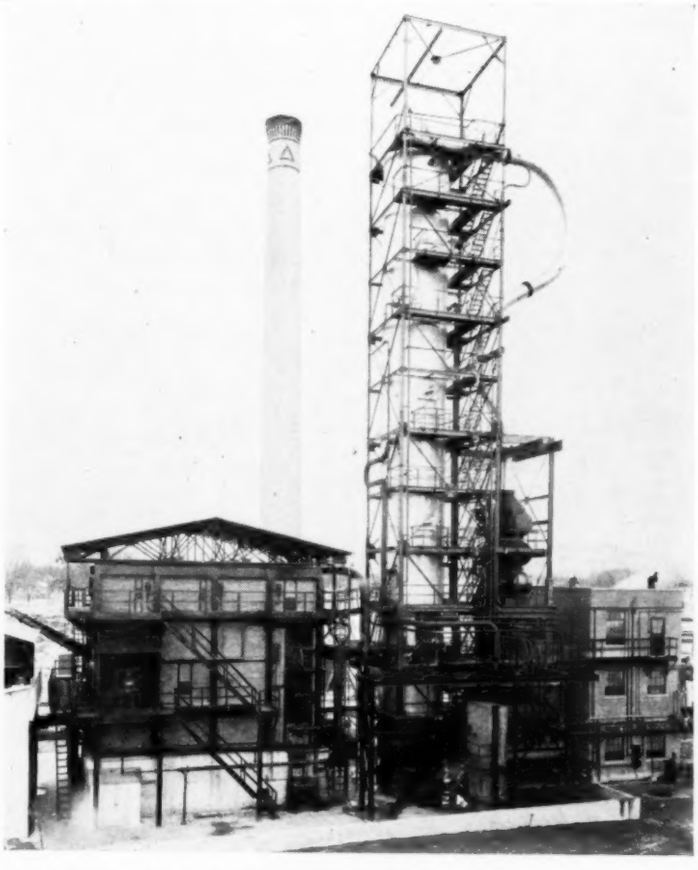
* Foster-Wheeler Corp.

DISTILLATION UNITS

By J. C. GLENN*

yield of cylinder stock would have to be considerably larger and therefore more expensive than the tower used. The other saving results from the materially smaller amount of steam required in the operation when the flash jug is used.

The increased size and efficiency of modern units is further demonstrated by a large rerun unit in an Eastern refinery which primarily processes Pennsylvania crude. This rerun unit handles a total charge of 8,000 barre'ls of 28.5 degrees A. P. I. gravity of pressed wax distillate or a charge of 8,000 barrels per day A. P. I. gravity bright stock solution or a combination of pressed wax distillate and bright stock solution. The primary saving in a unit of this kind is that the single unit accomplishes what would normally require two units almost as large as the one used. The operation is continuous and the desired final products are removed from the tower in separate streams. In addition to its novel function, this rerun unit incorporates several unusual features of design. Examination of the accompanying photograph shows an unusual tower insulation covering. The tower is insulated with the usual magnesium-asbestos composition. The insulation is in turn covered with sheet aluminum which provides an attractive and maintenance free weather-proof shield.



8,000 barrels per day rerun unit charging bright stock solution or pressed wax distillate or a mixture of the two. At the left is the tubular heater, fired by pulverized fuel and at the right is the pump house and receiving house.

The tower is equipped with special stripping sections made necessary because of the diversity of operation and products desired.

The tube still of the unit is built for the most economical means of firing depending upon full prices. It is equipped with hopper bottom for ash disposal and pulverized fuel equipment for firing in pulverized from the cheapest grade of solid fuels. The burners are designed for either pulverized fuel or oil burning or a combination of both. The still is equipped with hollow air-cooled walls which provide preheated air for use in the pulverized fuel equipment. This air is necessary for drying wet fuel, reducing power costs. To date the unit has been fired by fuel oil, pulverized petroleum coke, and pulverized bituminous coal.

The largest reduced crude vacuum distillation unit in the world also went into operation during the past year. This unit is in an Eastern refinery. It was designed for running Mid-continent, but in addition has also charged reduced crudes from Pennsylvania, Barbara Hill and Refugio fields.

The unit fractionates the residuum from 20,000 barrels of crude per day after the lighter fractions, constituting about 50 per cent of the original charge, have been removed. The products recovered are gas oil, wax distillate, heavy wax distillate, and overhead cylinder stock and a residuum of heavy flux. The tower which handles this charge in a continuous stream is 21 feet in diameter and is equipped with complete accessories, including vacuum actuating system, heat exchangers, condensers and final coolers. The heat exchangers and condensers are of the shell and tube type and the final coolers are of the tank and coil type. The original crude charge is preheated to a temperature of approximately 260 degrees F. in the vapor heat exchangers of the existing battery of shell type topping stills. The heat exchangers of the vacuum unit further preheat the crude to 350 degrees F. before it is returned to the shell still battery. The reduced crude is returned from the topping stills at a temperature of about 500 degrees F. and is preheated in the vacuum tube still to 780 or 800 degrees F. The charge is then delivered to the vaporizing chamber of the fractionating tower.

Maximum yield of overhead cylinder stock is obtained by the use of highly superheated steam in the tower. Ordinarily all of the overhead cylinder stock is taken from the tower at a single cut, but provision is made in this unit for taking off two streams of overhead cylinder stock when desired. When the cylinder stock is removed in two cuts, one has a viscosity of 125 and the other a viscosity of 300. Otherwise the operation of the tower is similar to vacuum towers of 14,000 bbls. per day crude units described above.

One of the largest topping units in the world is a single pass atmospheric unit which has now been in service about a year handling 15,000 bbls. per day of asphaltic base crude. This unit operates according to the arrangement indicated on the flow diagram PO-311-32. Gasoline vapors are recovered overhead and are condensed in shell and tube type heat exchangers. Naptha, kerosene and gas oil are recovered as liquid side streams, and a fuel oil is obtained as residuum.

The crude charge to this unit is preheated in exchangers before being delivered to the tube still. The tube still increases the temperature of the crude to 600 degrees F. and discharges into the vaporizing chamber at the bottom of the fractionating tower. The principal difference between this unit and the atmospheric stage of the 14,000 two-stage unit described above is the use of a settling tank necessitated by poor grade of crude sometimes charged. Before entering the still the preheated charge is delivered to the settling tank, where it remains about one hour, which is sufficient time to allow most of the sediment and water to separate out. The tank is insulated so that very little heat is lost while the settling occurs.

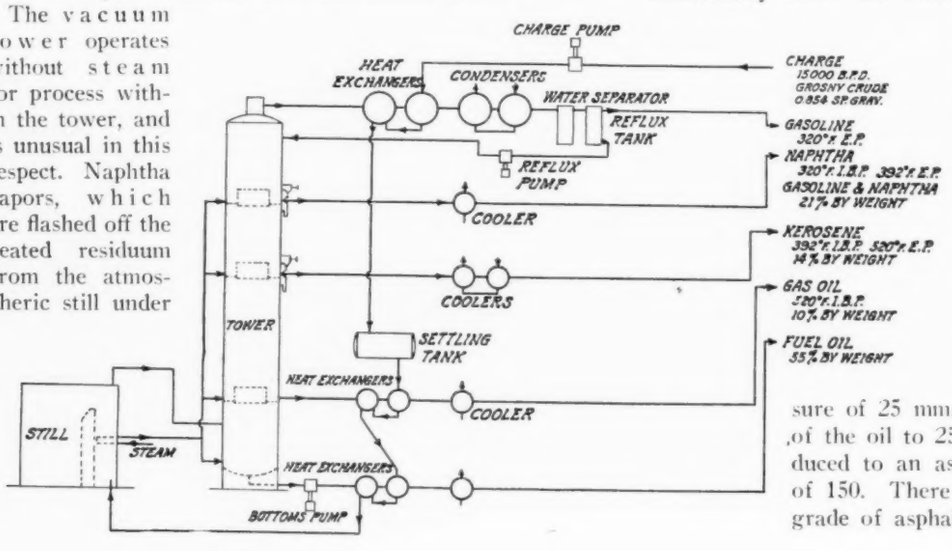
One of the most interesting distilling processes developed in recent years is the low temperature rerunning or pressure distillate. This distillation is accomplished without heating the distillate above 275 degrees F. at any point in the cycle, so that none of the anti-knock or other valuable characteristics of pressure distillate are neutralized.

The equipment is a two-stage atmospheric-vacuum unit complete with all accessories, such as heat exchanger, vacuum actuating system, run down tanks, coolers, pumps, etc. The only difference noticed in a superficial examination is the changed proportioning of the fractionating towers—the towers are large in diameter and low in height. Several of these units have been installed; the one shown by the accompanying photograph has a capacity of 8,000 bbls. of acid treated pressure distillate per day.

The charge is preheated in the heat exchanger of the overhead vapor line from the atmospheric tower and delivered to the tube still at a temperature of 165 degrees F. The path of oil through the tube still is rather unusual in that the preheated charge flows only through the roof tubes, where it is exposed to the radiant heat furnace. The charge leaves the roof tubes of the still at a temperature of 275 degrees F. and enters the flash chamber in the bottom of the atmospheric tower. The overhead vapors which are fractionated by passing through the several bubble trays are condensed by the shell and tube type exchanger and cooled in the tank and coil type cooler. The water is then separated out and a portion of the condensed gasoline is pumped to the top of the tower as reflux.

Steam which has been preheated in the tube still is passed into the reservoir of distillate at the bottom of the tower stripping off the lighter fractions. The bottoms from the atmospheric tower are circulated through the convection tube tank of the atmospheric still, where they are reheated to the original temperature of 265 degrees F. Part of the reheated pressure distillate is returned to the atmospheric tower and part is delivered to the vacuum tower.

The vacuum tower operates without steam for process within the tower, and is unusual in this respect. Naphtha vapors, which are flashed off the heated residuum from the atmospheric still under high vacuum, bubble through the trays in the upper portion of the tower and are condensed in a shell and tube type exchanger. The condensed overhead flows through a vacuum run down tank, whence same is sent to the top of the tower as reflux, and the balance pumped to storage. Residuum from the bottom of the vacuum tower is reheated in the vacuum tube still to the original temperature of 275 degrees F. so that the temperature is maintained in the reservoir. Accumulation is prevented by constant removal of bottoms from the tower, these bottoms being cooled in a tank and coil type cooler, from which they are sent to storage. The final residuum is used as charging stock for the cracking plant.



This type of equipment is very important for obtaining a maximum yield of premium motor fuel from acid treated pressure distillate. It is essential that the operation be carried on at low temperature because the chemical compounds in the solution polymerize or decompose at elevated temperatures. Another effect of high temperature distillation which is overcome is the formation of sulphur-dioxide, which causes corrosion. High temperature may also cause the formation of compounds which render the gasoline unstable to light and high in gum content. Steam stills have been used in the past to obtain these results, but the high steam consumption has rendered the steam still uneconomical in comparison with the high efficiency of the direct fired still.

Another new development is the vacuum flash jug for running Dubbs residuum to a salable asphalt obtaining as overhead a cracking still charging stock. Such a unit was recently put into service at a Midwest refinery. This type of unit promises to be an important source of revenue to many refiners who have trouble at present in disposing of cracking plant residuum at a profit. This unit is extremely simple in design and economical in operation inasmuch as the residuum is received from the cracking plant at a temperature high enough to dispense with further heating. The only heating necessary in the entire unit is the superheating of process steam and this is accomplished in a small separately fired superheater.

Residuum from the cracking plant is received at a temperature of 700 to 725 degrees F. and is pumped into the flash jug in a continuous stream at the rate of 1,000 bbls. per day. The vacuum actuating system in the overhead vapor line creates a high vacuum (50 mm. of mercury absolute pressure). The lighter fractions or gas oil flash into vapor at the reduced pressure and pass up through the tower. They are condensed by a shell and tube type condenser which discharges to the vacuum run down tank immediately below the condenser. The gas oil is then cooled so that it may be safely handled and is returned to the cracking plant, where it is used as charging stock for the cracking unit. Steam is superheated in a separately fired superheater to a temperature of 700 to 750 degrees F. and is passed through the residuum at the bottom of the tower efficiently stripping off all remaining gas oil. The steam is in sufficient quantity so that it exerts a partial pressure of 25 mm., reducing the partial pressure of the oil to 25 mm. The residue is thus reduced to an asphalt which has a penetration of 150. There are a number of uses for this grade of asphalt; it is readily marketed.

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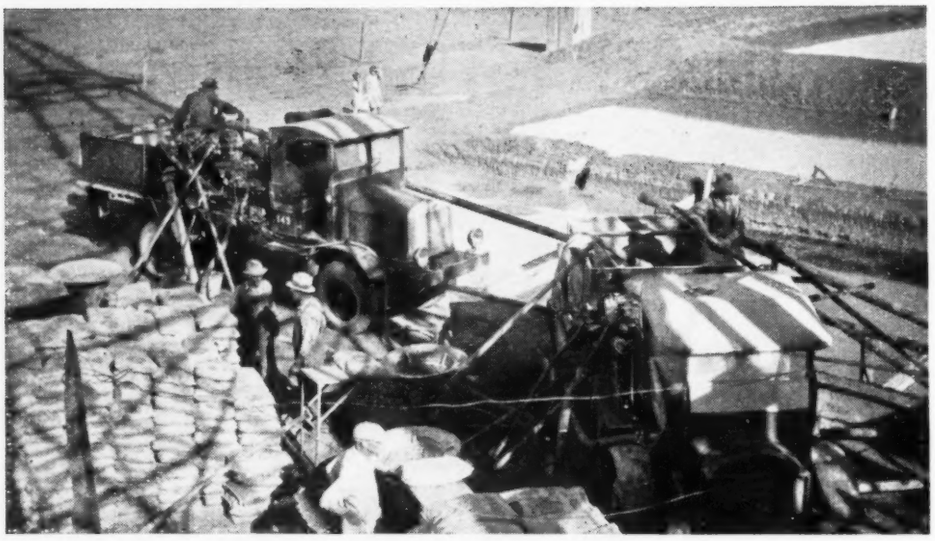


Hook-up of cementing trucks.

5500 Feet *of* Casing Cemented *in* 34 Minutes

▼

ONE of the most interesting phases of drilling operations in the new Greasewood Dome field, Colorado, is the method of cementing casing strings. The bottom hole temperature is quite high, which accelerates the hardening of the cement, consequently all cementing operations must be speeded up to the maximum and ice used to cool the circulating mud to prevent large quantities of cement setting in the casing.

Speeding up cementing operations has resulted in establishing what is considered a record time for cementing a string of 9⅝-inch casing at 5,500 feet. The Continental Oil Company's Gadbois No. 1 was cemented with 900 sacks of cement in the total time of 34 minutes. It took 13 minutes to mix the 900 sacks of cement and 21 minutes to place the top cementing plug at 5,440 feet.

E. F. Moran was the contractor and Halliburton Oil Well Cementing Company did the cementing. It was largely due to their co-operative efforts and the arrangement of mechanical equipment that the well was so quickly cemented. Two cement trucks and three cement mixers were used, the trucks being placed on the uphill side of the well, with the slush pits between the well and the trucks. A large galvanized tank was placed in the cooled slush pit and the cement was discharged from mixers to this tank, where the regular slush pumps picked it up and pumped it into the hole. After the pipe had been landed the well had free circulation — a factor that doubtlessly aided in the rapid placing of the cement in the hole.

This is not the only well in the field where a quick cementing job has been successfully carried out. On the Reiter-Foster Oil Corporation's Juhl-Johnson No. 1, 900 sacks of cement were dumped in 12 minutes and the total cementing time was 48 minutes.

On all the wells now being completed in the field ice is used to aid in getting the cement behind the casing, from 14 to 18 tons being placed in the mud circulating pits prior to running casing. The object of the ice is to reduce the temperature of the drilling fluid to help overcome the accelerating effect of high bottom hole temperature on the setting of the cement while it is being pumped down the pipe and up around the outside of the casing string. After the pipe has been landed this cooled mud is used for circulating.

Since about 900 sacks of cement are used in setting the 9⅝-inch casing at a point below 5,000 feet, which amount fills up several thousand feet behind the casing, it may readily be seen that it would be difficult to successfully place this amount of cement in direct contact with a high-temperature hole. By cooling off the circulating mud while running casing, it allows the operator to circulate this cooled mud after the casing has reached bottom, thereby reducing the temperature of the hole just before cementing. An additional amount of ice is placed in the cement mixing water as a further aid in retarding the setting of the cement.

The men in charge at the cementing of the Juhl-Johnson well, from left to right: Cyclone O'Donnell, Halliburton cementer; Carl Ludders, superintendent Re'ter-Foster; H. C. Gloeckler, vice-president, Halliburton Oil Well Cementing Co.; Jay Taylor, Halliburton division superintendent; Fred Manning, drilling contractor; Lloyd Terry, partner of Manning; Jabe Tidwell, Halliburton driver; Perry, tool-pusher for Manning & Terry; Buck Beddingfield, Halliburton cementer; H. W. Shutton, Halliburton driver. Photo taken by C. P. Parsons, field engineer for Halliburton.

Importance of Accurate Alignment *of* Diesel Bearings

By CHARLES C. KEANE, *Division Machinist, Great Lakes Pipe Line Co.*

THE renewal and adjustment of Diesel engine main bearings is an art that should be undertaken only by those thoroughly acquainted with the reaction of a crankshaft when in alignment and misalignment. A misaligned bearing will cause a fracture in the largest crankshaft and several such bearings in a multi-cylinder bed plate make operation of the unit positively dangerous.

Tools necessary for renewal or initial installation of a set of main bearings should include good scrapers, a set of inside micrometers, a bridge gauge with micrometer head, a dial indicator, feeler gauges and a high grade groove base level.

Diesel engine main bearings may be classified generally as vertical engine and horizontal engine bearings. There are many different designs of both, but as a sample installation, a six-cylinder vertical engine having eight bearings will be used.

It is assumed the bearings are concentric cast-iron shells, lined with high grade babbitt, accurately machined inside and out, upper and lower halves interchangeable with ¼-inch shimming between the halves to permit adjustment of running clearance.

The factory method of installation is as follows:

The engine bed plate is carefully leveled and bolted securely to the test floor girders. The plane machined surface on which the cylinder frame stands is thoroughly scrutinized for any distortion that may have occurred due to the bolting down process. This scrutiny is made with the aid of master straight edge about six feet long, which discovers distortion readily by means of feeler gauges. The bed plate being free of all strains, the main bearing caps are removed. The lower half shells are fitted in their respective places, each receptacle and shell being similarly stencilled. It is good practice to lap the lower half shells in place with medium grade grinding compound. The upper half shells are fitted in similar manner to their respective caps and stencilled to coincide with the lower halves. All shells are removed, cleaned and given the initial fit, which is made on a cast-iron, hollow, ground finish mandrel, having its diameter equal to the crankshaft journals. An 80 per cent bearing surface should be secured in this initial fit, after which the lower halves are placed in the bed plate ready for aligning.

The mandrel, which is light and easily handled, considerably speeds up the time taken in fitting the bearings. Its length covers about four bearings, beginning at the flywheel end. The first four bearings are scraped until a good fit and perfect leveling are secured.

The mandrel is then moved to cover bearings numbers two, three, four and five. Number five is scraped to alignment with the preceding four bearings and the mandrel is then moved one bearing at a time until the eight bearings are aligned, properly fitted and level. Skillful scraping can only be attained by constant practice; in fact some workmen never learn how to use a scraper properly.

The crankshaft is lowered in place and the thrust collar adjusted. The lateral given this collar depends on the engine shaft size, speed and system of lubrication. A 600-H.P. engine with pressure lubrication and an 11-inch shaft should run on .015-inch to .020-inch thrust collar lateral.

In properly designed engines the thrust is taken up at one place in the shaft only. This permits free lateral expansion on both sides of the thrust bearing. The crankshaft is rotated in the lower half bearings and tested for bearing surface. After fitting with the mandred very little adjustment is needed to get the shaft straight and level. The upper half bearings are set in place and tightened down by the caps minus the shims. The shaft is now ready to check for weave in the various cranks. Usually in a vertical engine, weave checking between top and bottom centers is all that is necessary. The checking is done with an inside micrometer, and highly finished crankshafts have gauge points between the webs. It is absolutely essential to have the top half bearings tightly clamping the shaft, as shafts of large diameter will not distort in case of a low bearing, unless sufficient weight is brought to bear on them.

A low bearing in a multi-cylinder engine should be readily found. If it is between a pair of consecutive cranks it will distort those cranks between top and bottom centers, and if it is at the ends it will affect only one crank, that is the one nearest to it. A high bearing will also cause a shaft to weave, but in the opposite direction. The micrometer measurements between top and bottom center of all cranks should not vary more than .002-inch or .003-inch, assuming of course, it is a straight and flawless shaft.

Leads should be taken between the bearing halves to determine the amount of shims to be used. The running clearance is added to this .0005-inch per inch diameter of shaft may be safely used with pressure lubrication.

A bridge gauge check of the respective bearings should be stencilled on the bridge gauge and kept for reference. A bridge gauge if properly used will detect low or worn bearings readily, but is of doubtful value on a shaft with irregularly worn journals.

The upper half shells with shims may now be replaced and the caps clamped down in order, beginning at No. 1; after clamping each cap, the crankshaft should be rotated by hand power to see that no particular cap is binding the shaft.

Such is the factory method of fitting and aligning main bearings.

Performing the above described job in the field calls for a slightly different method. The cylinder heads, pistons and connecting rods should be removed, and, assuming it is a six-cylinder engine, chain blocks could be rigged over No. 2 and No. 5 cranks, which should be in line on a six-cylinder four-cycle engine. The crankshaft could be picked up through No. 2 and No. 5 cylinders and the work done as in the factory, with the exception that no mandrel would be used. Before picking the shaft up, it should be tested with a dial indicator to ensure its being straight.

Shoulders showing on the journals should be removed by careful filing, and if the shaft has been operating under stress it should be thoroughly examined for fractures.

When the lower half bearings are all fitted and in place, each one should be tested to see if it is carrying sufficient

weight. This testing may be done with a block of wood and sledge, the block being held on the bearing shell and tapped lightly by the sledge. A low bearing not carrying sufficient weight will move easily; a high one will be exceptionally solid. If chain blocks are not available, jacks can be used to pick the shaft up, and whether chain blocks or jacks are used compression bolts and tie bolts should be used between and across the crank webs to prevent bending strains in the shaft.

Another method in common practice is the use of a pulling tool to remove the old bearings and install the new ones. This method is all right if one or two bearings are being removed, but for a complete set it has many objections, the principal being false markings shown on bearings when an adjacent bearing has been pulled.

It is possible to fit a complete set by using the pulling tool. It must be remembered it takes at least a half revolution of the fly wheel, using the pulling tool, to remove each lower half bearing, or this continuous rotation of the shaft causes false markings to register on bearings not being pulled, making accurate scraping difficult.

Renewal or complete installation of horizontal engine bearings is somewhat different from the same work on a vertical engine. To begin with, horizontal engine bearings differ very much in design. There are two-piece, three-piece and four-piece bearings. Some have concentric, interchangeable shells, others have wedge adjusted bottom shells. There are three-piece, wedge adjusted thrust shells with floating caps, having numerous tie and compression bolts to prevent the bearings from floating, and four-piece wedge adjusted thrust and compression bearings with top and bottom quarters spherical self-aligning. All these types have their advantages and disadvantages. The two-piece bearing with bottom shell set at 30 degrees from the horizontal plane, rigidly clamped with shim adjustment between the halves, so that the crankshaft impulses are taken in the center of the lower half bearing, is one of the best in use. There is nothing floating or likely to float about this bearing and a crankshaft thus supported has an excellent chance of running perfectly for years.

In single cylinder engines the shaft lateral should be taken up by the main bearing nearest the flywheel. Thrust collars are rarely used on horizontal engine crankshafts, therefore, the bearing taking the thrust should be a very snug fit between the shaft fillets. It is most important that the bottom bearings are a good fit, in alignment and level. If the two engine bearings are O. K. it is a simple matter to align the outboard bearings.

In twin cylinder horizontal engines the crankshaft thrust is usually taken by the middle main bearing and this bearing should be a snug fit between the crankshaft fillets. The usual methods of fit, alignment and leveling should be used.

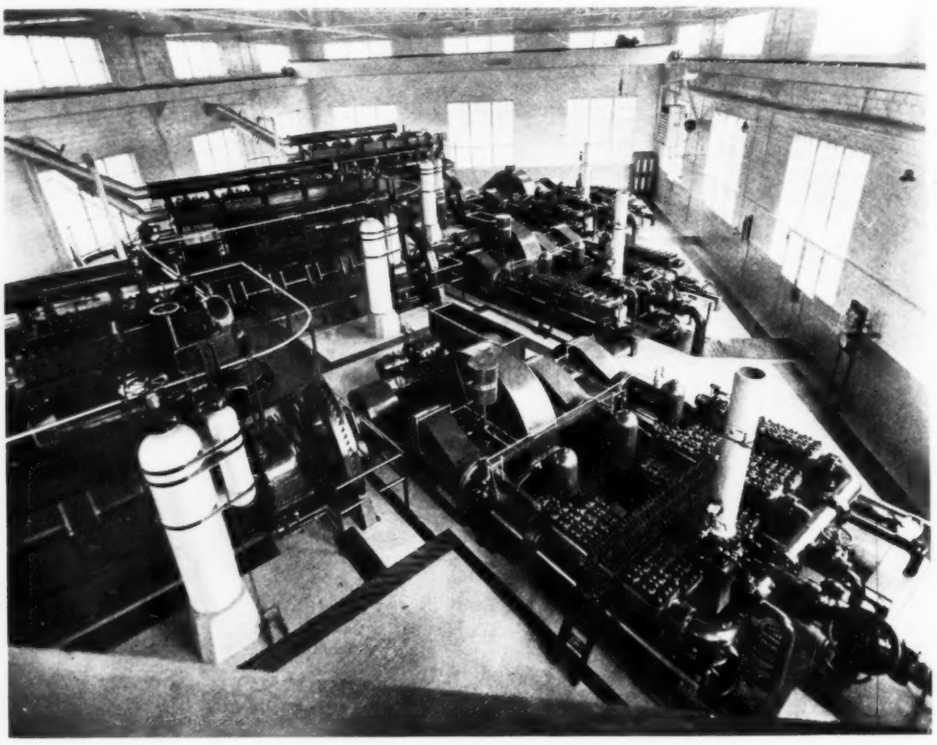
Nearly all horizontal engine crankshafts are fitted with counter weights. Between the extreme end of these weights is an excellent place to check the crankshaft weave. Two small opposite surfaces between the weights should be chipped and carefully filed. Micrometer checkings may then be taken across these points. Self-aligning bearings have a spherical register which permits them to swing in line within certain limits. Of course, if one bearing happens to be thicker than the other, this must be rectified by scraping.

In ring oil bearings, particular attention should be paid to the crankshaft oil throwing rings and the oil catcher plates on the bearing sides. These plates very often leak and are the cause of burned out or hot bearings.

The plates should be a good fit, free from dirt, and there should be ample room between the plate and bearing side to permit easy passage of the overflow oil back to the bearing cellar.

Properly fitted bearings, with the right amount of running clearance, clean high grade lubricating oil, of ample surface and running at a speed that is not critical, will last for years.

The crankshaft of a horizontal engine should never be permitted to whip as this causes checking of the babbitt and short bearing life.



Interior view of Diesel Powered Pump Station.

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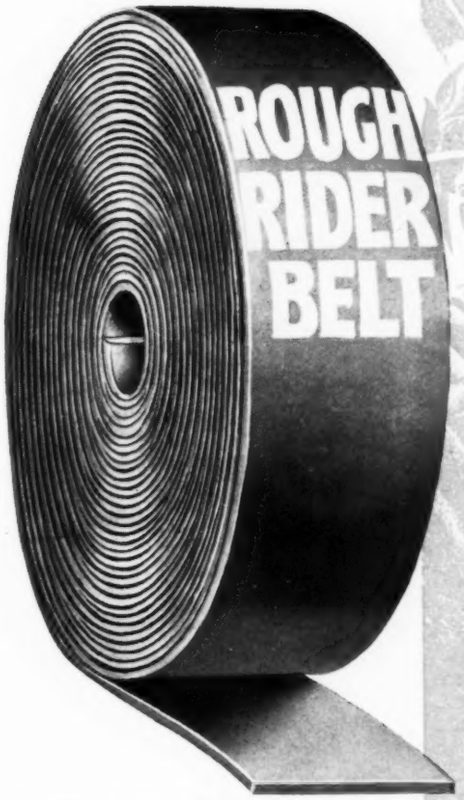

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PE-1-32-Gray

General view showing both retaining walls and concrete apron.

MAINTAINING CREEK CROSSING *with* CONCRETE

INNOCENT appearing streams are frequently the most troublesome water crossings operating crews have to contend with. Especially is this true in the plains country where streams and freshets, in the trough of a huge water shed, become torrents during a severe rain storm.

During such periods the water rips the covering from submerged lines and often causes a break in the line. Repair of the break, under such conditions, usually is a temporary measure because the stream often starts cutting a new channel exposing the line to an attack from a different angle. Under such conditions anchoring the line with concrete blocks or staking it in with piles frequently fails to care for the changing course of the stream.

Ten years ago a 12-inch coupled gas line in Kansas often gave trouble, usually at a time when the line's service was needed, because a stream continued to wash out the crossing. Originally the line crossed the stream, 18 feet wide, at a slight angle. Heavy rains caused the stream to swell and start cutting a new channel.

As a result the current attacked the line at two points, one where it crossed directly over and again a short distance upstream where the current swung around and started cutting the dirt away from the side of the line.

To hold the line in place and to tame the temperamental creek a concrete apron was built over the line in the stream bed and concrete retaining walls were constructed to prevent a further change of course in the stream at this point. This work has been in ten years and during that time the crossing has given no trouble. It will probably last as long as the line itself and was economical to build.

The apron was built by gathering rocks from the creek bed and its banks and dumping them over the line where it crossed the channel. Concrete was then poured over the rocks to hold them in place and prevent the cutting action of the current reaching the pipe.

Opposite the apron a retaining wall was built to prevent the current from cutting farther out and at the same time keep it from cutting behind the apron. Upstream, and starting at the end of the apron, another retaining wall was built. This was at the point where the current made a side sweep at the line and was threatening to undermine it just before the pipe entered the stream.

In constructing the retaining walls, forms 12 inches wide and sunk a couple of feet deep were made. The concrete was reinforced with small diameter pipe. After the forms were removed the retaining wall was further strengthened by driving piling, made with four- and six-inch pipe, alongside the walls.

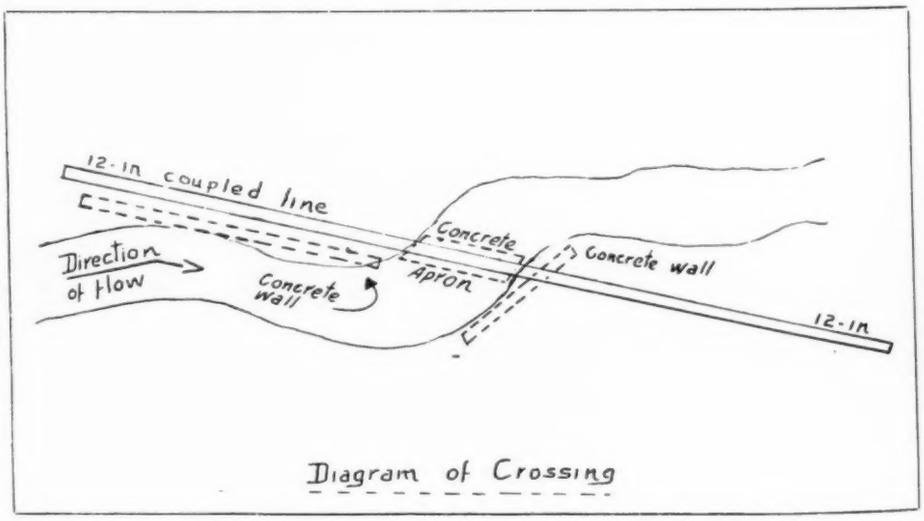

Diagram of Crossing

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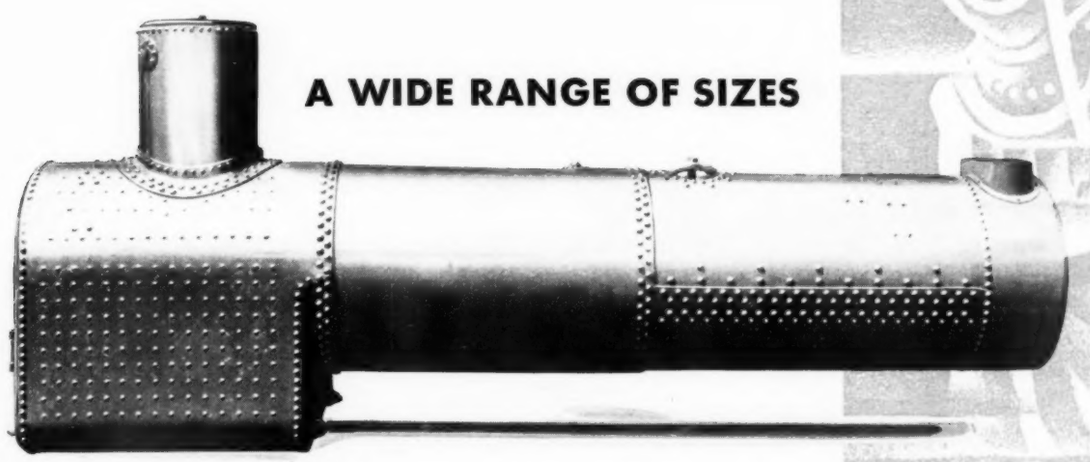

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CONTINENTAL

PE-1-32-Grav

Combustion in the Refining Industry

Article No. 2

By SIDNEY BORN, *Ph. D.*

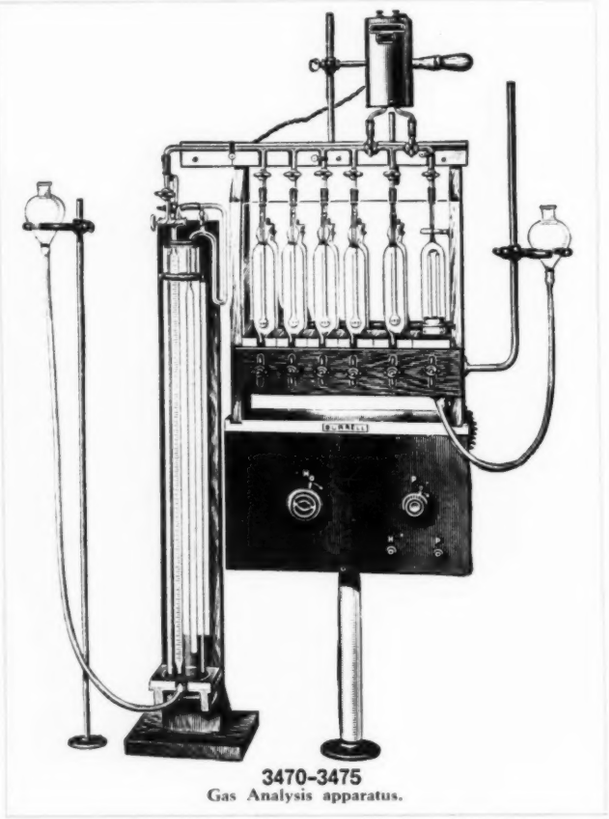
AS it is quite important to know the percentage of sulphur in fuels, we are giving herewith a method commonly used for the determination of sulphur in fuel oils. This method is also applicable to the determination of sulphur in coke, coal, and tarry residues.

(A. S. T. M. Method D129-27) Apparatus

1. The oxygen bomb shall have a capacity of not less than 300 ml., and shall be of a design or construction such that no leaks shall occur at any pressure or temperature generated during the test and such that when the bomb is open liquid contents can be easily and completely drained. The inner surfaces shall be of materials that are chemically and physically resistant to the process or products of combustion. The gaskets, insulating materials, etc., shall be, as far as possible, physically and chemically resistant and in no event shall they undergo any reaction which would increase or decrease the sulphur content of the bomb liquors.

2. The oil cup shall be of platinum, glazed silica, or other suitable material, with a capacity of not less than 2.5 ml. nor more than 5.0 ml.

3. If a platinum oil cup is used, the fuse wire shall be of platinum if a glazed silica oil cup is used, the fuse wire may be of either platinum or iron. No. 35 B. & S. gauge is a convenient size.



3470-3475
Gas Analysis apparatus.

Solutions Required

4. (a) The distilled water and all reagents should be sulphur free, but in such cases where it is necessary to employ reagents not sulphur free, blanks shall be run and the figures thus obtained used to correct the results of actual determinations.

(b) Barium Chloride.—The barium chloride solution shall contain 100 g. of $BaCl_2.2H_20$ per liter.

5. (a) Twenty milliliters of distilled water shall be placed in the bottom of the bomb. From 0.6 to 0.8 g. of the oil to be tested shall be placed in the weighed oil cup and the weight of this charge shall be determined to an accuracy of at least ±A0.002 g. The cup shall be placed in the proper position in the bomb, the ignition mechanism arranged and the bomb closed. Oxygen shall be admitted slowly until a pressure is reached as indicated by the following table:

Capacity of Bomb, ML.	*Minimum Gauge Pressure Atmospheres*
300 to 350	40
350 to 400	35
400 to 450	30
450 to 500	27.5
Above 500	25

The leads from the firing circuit shall be attached, the bomb placed in a bucket of cold water, and ignited. The bomb shall be allowed to stand in the water for 10 minutes and shall then be removed. The valve of the bomb shall be opened, allowing the gas to escape at an approximately even rate so that the pressure is reduced to atmospheric in not less than one minute. The bomb shall be opened, and all parts of its interior, including the oil cup, rinsed with a fine jet of distilled water. All washings, which should not amount to more than 350 ml. shall be collected in a beaker. Particular care should be taken not to lose, by splashing, or otherwise, any of the liquid contents of the bomb. The washings shall be filtered through a washed "qualitative" filter paper. The filter shall be washed thoroughly. Two milliliters of concentrated MC1 and 10 ml. of saturated bromine water shall be added to the filtrate. The solution shall be evaporated to about 75 ml. on a steam bath or hot plate. Ten milliliters of hot barium chloride solution shall be added in a fine stream or drop-wise to the hot solution, stirring during the addition and for two minutes afterward. The solution shall be allowed to stand over night, or shall be kept hot for one hour on the steam bath or hot plate, allowing the precipitate to settle for another hour, while cooling. The supernatant liquid shall be filtered through an "ashless quantitative" filter paper, the precipitate washed with water, first by decantation, then on the filter, till free from chloride. The paper and precipitate shall be transferred to a suitable weighed crucible, dried at low heat till moisture is evaporated, the paper charred (without flaming), and finally ignited at a good red heat till the precipitate is just burned white. A satisfactory means of accomplishing these operations is to place the crucible containing the wet filter paper in a cold electric muffle furnace and to turn on the current. Drying, charring, and ignition will usually occur at the desired rate.

(b) After ignition is complete, the crucible shall be allowed to cool to room temperature, and weighed. The use of a desiccator is not recommended.

(c) From the increase in weight of the crucible the

percentage of sulfur shall be calculated from the formula:

$$\text{Percentage of sulfur} = \frac{\text{Grams of } BaSO_4 \times 13.734}{\text{grams of oil used}}$$

Accuracy

6. Duplicate determinations should agree to ±2 per cent on the basis of the sulfur found.

The determination of nitrogen in fuels is seldom required. It is determined by burning a weighed amount of the fuel in a combustion tube, absorbing the carbon dioxide, and water evolved, and measuring the nitrogen in a suitable eudiometer under certain fixed conditions. We refer those readers interested in the details of this method to any standard handbook on organic analysis.*

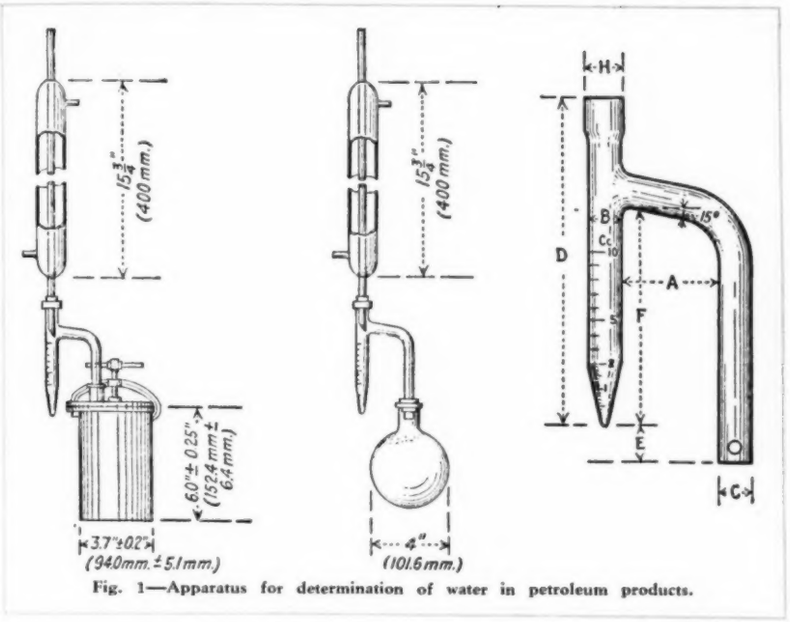


Fig. 1—Apparatus for determination of water in petroleum products.

The amount of ash or incombustible residue is a very important determination especially in coal and coke. It is very seldom made on petroleum oils, as the percentage present in normal petroleum fuel oils is usually extremely small. The following method is one commonly used for this determination:

One gram of coal, either freshly weighed or that which has been used for the moisture determination, is ignited in a shallow capsule or porcelain crucible by placing directly in a muffle maintained at a dull or cherry-red temperature between 700 and 750° C. and retained at this temperature for 20 or 30 minutes or until all of the carbon is burned out. The capsule is cooled in a desiccator and weighed. In the absence of a muffle the desired temperature may be obtained by placing the capsule at first just above the tip of a Bunsen flame turned down to about two or three inches in height. After the larger part of the carbon is burned off in this manner the flame is increased so that the tip comes well into contact with the bottom of the capsule.

For coals having carbon dioxide present in an amount exceeding 0.2 per cent, the ash after cooling is moistened with a few drops of sulphuric acid (diluted 1:1) and again carefully brought up to 750° C. and retained at that temperature for three to five minutes. The crucible is cooled in a desiccator and weighed. Three times the equivalent of carbon present as carbon dioxide is subtracted from the ash as weighed in order to restore the weight of the calcium sulphate formed to the equivalent of calcium carbonate.

It is also necessary to know the percentage of moisture present in fuels. In the case of petroleum fuels, A. S. T. M. Method D95-30 is usually employed.

1. This method of test determines water existing in a sample of bituminous material by distilling the sample with a volatile solvent. This method is suitable for a variety of materials but is especially applicable to petroleum, fuel oil, road oil, coal tar, water-gas tar, coke, oven tar and other petroleum products or bituminous materials.

Apparatus

2. The apparatus shall consist of a metal still or glass flask, heated by suitable means and provided with reflux condenser discharging into a trap connected to the still or flask. The trap serves to collect and measure the condensed water and to return the solvent to the still.

*See H. L. Fisher's Laboratory Manual of Organic Chemistry, John Wiley & Sons.

GRADE OF OIL	Flash Point		Water and Sediment Maximum	Pour * Point Maximum	Distillation Test			Viscosity Maximum
	Minimum	Maximum			10% Point Maximum	End Point Maximum	90% Point Maximum	
			Per cent					
No. 1, light domestic fuel oil. (A light distillate oil for use in burners requiring a high-grade fuel.)	110° F. or legal	165° F.	0.05	15° F.	420° F.	600° F.	.....	.....
No. 2, medium domestic fuel oil. (A medium distillate oil for use in burners requiring a high-grade fuel.)	125° F. or legal	190° F.	.05	15° F.	440° F.	.....	620° F.	.....
No. 3, heavy domestic fuel oil. (A distillate fuel oil for use in burners where a low-viscosity oil is required.)	150° F. or legal	200° F.	.1	15° F.	460° F.	.....	675° F.	Saybolt universal at 100° F. 55 seconds

* Lower or higher pour points may be specified whenever required by conditions of storage and use. However, these specifications shall not require a pour point less than 0 degrees F. under any conditions.

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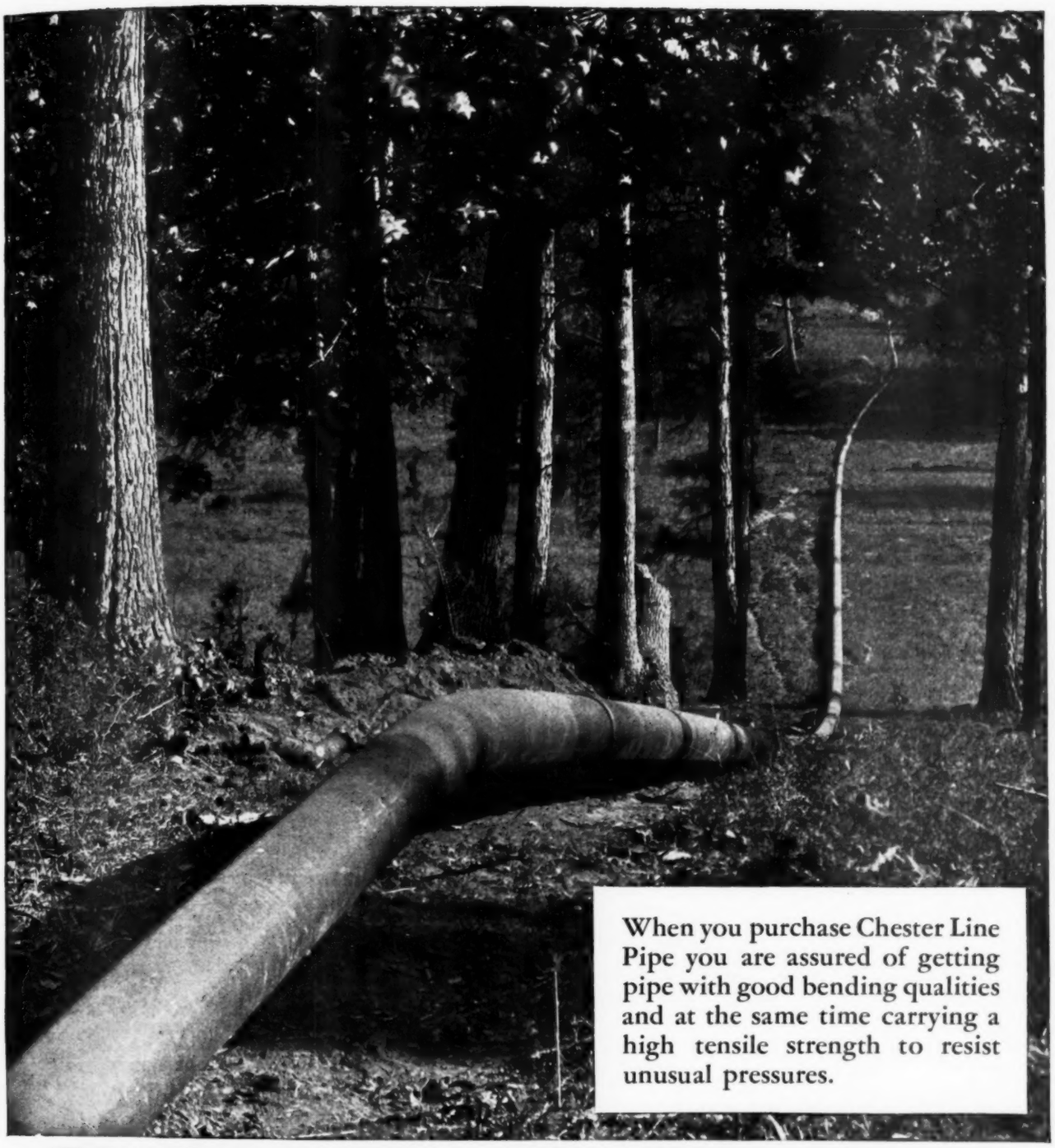

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The type of distilling apparatus used is not an essential feature of this method, but glass has been generally used for petroleum products and the metal still for road materials and tars.

3. (a) The metal still (Fig. 1[a]) shall be a vertical cylindrical vessel, preferably of copper, having a faced flange at the top to which the head is tightly attached by means of a clamp. The head shall be of metal, preferably of brass or copper, and be provided with a tubulation 1 inch in inside diameter.

(b) The glass flask (Fig. 1[b]) shall be of the short neck, round-bottom type, made of well-annealed glass, having an approximate capacity of 500 ml.

4. The burner used with the metal still shall be a ring gas burner 4 inches (100 mm.) in inside diameter. With the glass flask, an ordinary gas burner or electric heater may be used as the source of heat.

5. The condenser shall be of the water-cooled, reflux, glass-tube type, having a condenser jacket not less than 400 mm. (15¾ inches) in length with an inner tube 9.5 to 12.7 mm. (⅜ to ½-inch) in outside diameter. The end of the condenser to be inserted in the trap shall be ground off at an angle of 30 degrees from the vertical axis of the condenser.

6. The trap shall be made of well-annealed glass constructed in accordance with Fig. 1 (c) and shall be graduated as shown from 0 to 10 ml. in 0.1 ml. divisions. The error of any indicated capacity shall not be greater than 0.05 ml.

The outside diameters should be preferably 2.5 to 3.5 mm. (3/32 to ⅛-inch) greater than the inside diameters specified.

7. (a) The solvent used when testing petroleum products or bituminous materials derived from petroleum shall be gasoline free from water and shall conform to the following distillation requirements, determined in accordance with the Standard Method of Test for Distillation of Gasoline, Naphtha, Kerosene and Similar Petroleum Products (A. S. T. M. Designation: D 86) of the American Society for Testing Materials.

Five per cent shall distill at a temperature not below 190° F. (90° C.) nor above 212° F. (100° C.); 90 per cent shall distill below 410° F. (212° C.).

(b) The solvent used when testing bituminous materials derived from coal tar, water-gas tar, etc., shall be a coal-tar naphtha or a light oil and shall conform to the following distillation requirements, determined in accordance with the Standard Method of Test for Distillation of Gasoline, Naphtha, Kerosene and Similar Petroleum Products (A. S. T. M. Designation: D 86) of the American Society for Testing Materials:

98 per cent shall distill between 248° F. (120° C.) and 482° F. (250° C.).

Sample

8. The sample shall be thoroughly representative of the material to be tested and the portion of the sample used for the test shall be thoroughly representative of the sample itself. Deviation from this requirement shall not be permitted.

NOTE.—The difficulties in obtaining proper representative samples for this determination are unusually great so that the importance of sampling cannot be too strongly emphasized.

Procedure

9. When the sample to be tested contains less than 10 per cent of water, exactly 100 ml. of the material to be tested shall be placed into the still or flask and thoroughly mixed with an equal volume of solvent by swirling, proper care being taken to avoid any loss of material. If the material is measured by volume, an accurate 100-ml. graduated cylinder shall be used and the contents transferred to the still by rinsing with one 50-ml. portion of solvent followed by two successive 25-ml. portions of solvent, the cylinder being allowed to drain each time. When the sample to be tested contains more than 10 per cent of water, the volume of material used shall be decreased to that which will yield somewhat less than 10 ml. of water.

NOTE.—In special cases where the water content exceeds 10 per cent and it is not desirable to reduce the size of the sample to that which will yield somewhat less than 10 ml. of water, a distilling tube receiver graduated from 0 to 25 ml. may be used. This tube shall be graduated from 0 to 2 ml. in 0.1 ml., from 2 to 5 ml. in 0.2 ml. and from 5 to 25 ml. in 0.5 ml.

The connections between the still or flask, trap and condenser shall be made by means of tight-fitting corks as shown in Figs. 1 (a) and (b). The end of the condenser inserted in the trap shall be adjusted to that position which will allow the end to be submerged to a depth of not more than 1 mm. below the surface of the liquid in the trap after distillation conditions have been established. When the metal still is used, a heavy paper gasket moistened with the solvent shall be inserted between the lid and flange

GRADE OF OIL	Flash Point		Water and Sediment Maximum		Pour Point Maximum	Viscosity Maximum
	Minimum	Maximum				
			per cent			
No. 4, light industrial fuel oil. (An oil known to the trade as a light fuel oil for use in burners where a low viscosity industrial fuel oil is required)	150° F.	(a)	1.0		(b)	Saybolt universal at 100° F. 125 seconds
No. 5, medium industrial fuel oil. (Same as Federal Specifications Board specification for Bunker Oil "B" for burners adapted to the use of industrial fuel oil of medium viscosity)	150° F.		1.0			Saybolt Furol at 122° F. 100 seconds
			Water	Sediment		
No. 6, heavy industrial fuel oil. (Same as Federal Specifications Board specification for Bunker "C" for burners adapted to oil of high viscosity)	150° F.		(c)	0.25		Saybolt Furol at 122° F. 300 seconds

(a)—Whenever required, as for example, in burners with automatic ignition, a maximum flash point may be specified. However, these specifications shall not require a flash point less than 250 degrees F. under any conditions.

(b)—Pour point may be specified whenever required by conditions of storage and use. However, these specifications shall not require a pour point less than 15 degrees F. under any conditions.

(c)—The total water plus sediment shall not exceed 2.0 per cent.

before attaching the clamp. A loose cotton plug shall be inserted in the top of the condenser tube to prevent condensation of atmospheric moisture in the condenser tube.

Heat shall then be applied and so regulated that the condensed distillate falls from the end of the condenser at the rate of from two to five drops per second. The ring burner used with the metal still should be placed about three inches above the bottom of the still at the beginning of the distillation and gradually lowered as the distillation proceeds.

The distillation shall be continued at the specified rate until no water is visible on any part of the apparatus except at the bottom of the trap. This operation usually requires less than an hour. A persistent ring of condensed water in the condenser tube shall be removed by increasing the rate of distillation for a few minutes.

10. The volume of condensed water measured in the trap at room temperature multiplied by 100 and divided by the volume of the sample used shall be the percentage of water and shall be reported as " . . . per cent water by volume, A. S. T. M. method."

Accuracy

11. The accuracy to be expected with this method is that duplicate determinations of water should not differ from each other by more than one division on the trap.

In the case of coal or coke, the following method is commonly used.

Weigh out one gram of coal (60 mesh) in a weighed porcelain crucible (⅞"x1¾") and heat for one hour in a constant temperature over at 105°C. It is then cooled in a desiccator and weighed. The loss in weight multiplied by 100 equals the percentage of moisture.

If we know the percentage of carbon, hydrogen, sulphur, nitrogen, ash and moisture in a fuel, it is usually assumed that the percentage of oxygen is equivalent to the difference between the sum total of the above constituents and one hundred per cent. While the percentage thus obtained is subject to the cumulative errors of the other analyses, and also to certain errors due to chemical changes, the percentage of oxygen in ordinary fuels is so small that the errors introduced in this way are of no practical importance.

The above methods of analysis give us sufficient information to calculate the heating value of a fuel and to determine the amount of oxygen required for complete combustion. However, in order to determine the best methods of handling liquid fuels prior to combustion it is necessary to know certain other characteristics, such as the viscosity, the pour test, the flash point, and the distillation. In the case of coal and coke, it is desirable to know the percentage of volatile matter and fixed carbon, as these are important factors in determining furnace volumes necessary for satisfactory combustion.

The viscosity of an oil is the measure of its resistance to flow. A study of the viscosity of a liquid fuel gives us an idea of how it will flow through pipes, the power required for pumping, and its behavior on atomization. As the viscosity of liquid fuels decreases rapidly as the temperature increases, a study of the viscosity at various temperatures is of great importance. In the United States, viscosity is usually determined in the Saybolt Viscosimeter, using either a Standard or Furol tube, according to A. S. T. M. method D 88-26.

The pour test of an oil is the lowest temperature at which it will flow under prescribed conditions. It is of value in determining the lowest temperature to which the oil should be subjected without difficulty in handling. The pour test is usually determined according to A. S. T. M. method D 97-28.

The flash point is defined as the temperature to which an oil must be heated in order to give off sufficient vapor to form an inflammable mixture with air. The minimum flash point is generally specified by law in order to provide a fuel without undue hazard. The maximum flash point is sometimes specified to insure ease of ignition. The flash point may be specified on different types of apparatus, but is usually required according to A. S. T. M. method D 93-22 on the Pensky Marten's tester.

The distillation analysis of a liquid fuel gives a measure of the volatility of the fuel. It is generally made according to A. S. T. M. method D 86-27.

After considerable study and conferences with both refiners, distributors and users of liquid fuels, the U. S. Department of Commerce issued Commercial Standard CS 12-29 as a guide to the use of fuel oil for various purposes.

The specifications are as follows:

Gaseous Fuels

So far we have limited our discussion to the analysis of liquid and solid fuels. There are a large variety of gas analysis apparatuses on the market. These consist essentially of a burnette for measuring the gas, and a series of absorption chambers for removing the various constituents by chemical treatment, and measuring the volume of the residual gas after each operation.

TABLE—ULTIMATE ANALYSES OF COMMERCIAL FUEL OILS AND CRACKED RESIDUUMS

Source of Crude Oil	Stock	A. P. I. Gravity	Analyses—Weight Basis						Calorific Value		
									Gross		Net*
			Water	Carbon	Hydrogen	Ratio C:H	Sulphur	Undetd.	Calcd. from long formula	Obsd. dry oil basis	Dry oil basis
		Degrees	Pct.	Pct.	Pct.		Pct.	Pct.	B.t.u. lb.	B.t.u. lb.	B.t.u. lb.
Kentucky	Cracking	24.4	.....	87.1	12.53	6.95	0.22	0.15	20,494	19,358	18,168
	Flashed residuum	3.3	.....	90.6	8.49	10.70	0.41	0.50	18,506	17,837	17,030
	Normal residuum	15.2	0.05	88.7	10.23	8.65	0.30	0.72	19,292	18,651	17,677
California	Cracking	26.2	0.89	85.8	12.09	7.10	1.19	0.04	20,068	19,053	18,001
	Flashed residuum	8.0	0.05	88.3	9.50	9.30	1.20	0.95	18,748	18,084	17,179
	Normal residuum	16.5	0.05	87.5	10.17	8.60	1.14	1.14	19,146	18,319	17,351
Midcontinent	Cracking	25.3	.....	86.4	12.38	6.98	0.46	0.76	20,380	19,353	18,173
	Flashed residuum	10.7	.....	88.5	9.92	8.93	0.77	0.81	19,101	18,293	17,349
	Normal residuum	14.3	0.05	87.6	10.27	8.53	0.70	1.38	19,198	18,454	17,479
Midcontinent	Cracking	25.5	.....	86.5	12.38	6.99	0.46	0.76	20,308	19,182	18,002
	Flashed residuum	8.6	.....	88.9	9.80	9.06	0.56	0.74	19,077	18,277	17,345
	Normal residuum	22.0	0.05	87.4	11.10	7.87	0.42	1.03	19,657	18,778	17,723
Midcontinent	Cracking	25.1	0.33	86.2	12.39	6.96	0.39	0.69	20,286	19,256	18,076
	Flashed residuum	9.2	0.40	88.4	9.95	8.88	0.68	0.81	19,102	18,274	17,324
	Normal residuum	8.1	0.25	88.5	9.07	9.76	0.67	1.51	18,577	18,077	17,212
California	Cracking	18.7	0.05	85.6	11.40	7.50	1.60	1.35	19,639	18,607	17,522
	Flashed residuum	11.3	0.30	86.5	10.04	8.65	1.49	1.67	18,910	18,088	17,128
	Normal residuum	7.6	0.10	87.5	9.38	9.33	1.37	1.65	18,648	17,970	17,075

*Gross B.t.u. per pound observed — [(pound $H_2$9) + (pound H_2O present)] × 1057 = net B.t.u. per pound.

Illustrated herewith is a typical apparatus of this type.

After measuring the gas it is first passed through a solution of potassium hydroxide. This reagent absorbs carbon dioxide, and the percentage can be calculated from the difference in volume before and after absorption. As this reagent also absorbs hydrogen sulfide, sulfur dioxide and other acidic materials, a correction for these must be made in case they are present.

The gas is then passed through a solution of bromine water which absorbs the olefines.

Oxygen is determined by absorption with an alkaline solution of pyrogallol which absorbs this element.

Carbon monoxide may be determined either by absorption in a saturated solution of cuprous chloride, or else by combustion in the copper oxide pipette. As carbon monoxide and hydrogen burn at a much lower temperature than the paraffine hydrocarbons, a fractional combustion can be utilized to determine these various constituents.

After the removal of the carbon monoxide and hydrogen, the paraffine hydrocarbon gases are determined by combustion in the slow combustion pipette and the percentage of methane and ethane calculated from the results.

The residual gas is considered as nitrogen.

In the method given above, all the paraffine hydrocarbons are reported as percentage of methane and ethane, although higher members of the series, such as propane, butane, and pentane, may be present. However, for combustion work, such as calculating the products of combustion, air required for combustion, thermal value, etc., the data given by the preceding methods is sufficiently accurate. If it is desired to determine the percentage of the various paraffine hydrocarbons actually present, this may be done by fractional distillation at very low temperatures.

The calorific value of petroleum fuels can be accurately calculated if we know the percentages of carbon, hydrogen, sulfur, and oxygen. The Dulong formula which has been adopted by the American Society of Mechanical Engineers, is as follows:

$$\text{Calorific Value (in B. T. U. per pound)} = 146\ C + 620\ \left(H - \frac{O}{8}\right) + 40\ S$$

Using this formula, Faragher, Morrell and Essex (J. Ind. and Engineering Chem., Vol. 21, p. 933—1929) calculated the B.T.U. value of various commercial fuel oils and cracked residuums and compared them with values obtained by calorimetric determinations.

The same authors also investigated the relationship between calorific value in B.T.U. per lb. and A.P.I. gravity and found that this is a linear function. They propose the following formula for calculating the B.T.U. value of dry straight run fuel oils:

$$\text{B.T.U.} = 17010 + (90 + {}^\circ\text{A.P.I.}) \text{ per pound}$$

and for cracked residuums:

$$\text{B.T.U.} = 17645 + (54 + {}^\circ\text{A.P.I.}) \text{ per pound.}$$

Latest Methods Used in Operation of Wentz Northern Oklahoma Gasoline Plants

THE oil division of the Wentz Corporation operates a natural gasoline plant in the Tonkawa field and one in the Dilworth field in northern Oklahoma. O. H. Schoenwald is manager of the gasoline department of the company.

The stripped gas from the Tonkawa plant is used for repressuring. It is put back into the wells after it is compressed to 155 pounds per square inch.

The average gasoline content of the rich gas to this plant is 3.5 gallons per thousand cubic feet. The gas is sweet, and the gasoline produced requires no chemical treatment.

There are eight 80-horsepower Cooper-Bessemer gas engine-driven compressors, but only four are used at the plant on account of insufficient gas volume. The engine cylinders are 16x20 inches, and the compression cylinders 16x20 inches. The repressuring unit has a compressor 9x20 inches. About 450,000 cubic feet of gas can be treated daily, yielding from 1,800 to 2,000 gallons of natural gasoline.

The gas from the separators is first compressed to 35 pounds per square inch and is run through the cooling coils, which are sprayed with water, and finally enters a bubble type absorption tower. Mineral seal oil is used in this tower.

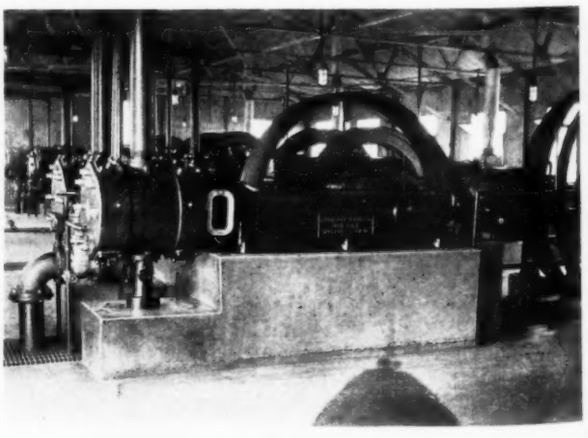
The fat oil is distilled in a Southwestern portable type unit. The tail gases are recompressed and recycled. The raw gasoline is stabilized to 95 per cent recovery in a unit designed by the company engineers.

River water is used at the plant after it is treated by a special process. Steam for the plant is generated by three field boilers, gas fired. The installation consists of three 65 and one 80-horsepower units.

The Dilworth gasoline plant is similar in type to the Tonkawa plant. The residue gas, however, is put into the fuel lines.

The gas is compressed to 45 pounds by three 85-horsepower Cooper-Bessemer gas engines (16x20 inches) driving Ingersoll-Rand compressors, each 12x18 inches. This plant has two 12x20 duplex vacuum pumps, two 12x12 duplex Ingersoll-Rand compressors and two 14x14 compressors direct-driven by 80-horsepower Clark engines. On account of insufficient gas, only one vacuum pump and two compressors are operating at present.

The gas is cooled with two Braun coolers and passed through a bubble type absorption tower using mineral seal oil. The tail gas is recompressed. The fat oil is distilled in a Southwestern unit and stabilized to 95 per cent recovery. About 2,000 gallons of natural gasoline is produced per day. It is sweet, requiring no chemical treatment. The boiler installation consists of three 45-horsepower field boilers, gas fired. Seven 8,000-gallon horizontal storage tanks are installed at the plant for storing the finished gasoline.



Compressor room at Wentz Corp.'s Dilworth station.

PIPING engineers and contractors who have designed and installed welded piping systems say that the presence of tangents and their length is one of the most important considerations in the selection of a type of welding ell. They all agree that tangents are highly desirable—particularly long tangents (exclusive with Midwest Welding Ells).

Here are the principal advantages of these longer tangents (¼″ for each inch of nominal diameter; a 12″ Midwest Ell has tangents 3″ long):

1. Pipe and ell are lined up more quickly and accurately —thus reducing installation time and cost.
2. Weld is removed from point of maximum bending stress.
3. Less pipe is needed (a 12″ Midwest Ell saves 6″ of pipe).
4. Short nipples and the extra welds they require are frequently eliminated.
5. Welds are more accessible.
6. Flanged ells are made with slip-on flanges that are welded front and back. This is impossible with welding ells having short tangents or none at all.

Other Important Advantages

Midwest Welding Ells have a long radius (1½ times the nominal diameter) instead of a short radius (one diameter) for these reasons:

1. Pressure drop is much less.
2. Less pipe is used (a 12″ Midwest Ell saves 12″ of pipe not including the 6″ saved by the long tangents).
3. Greater welding convenience that saves time.

The Midwest design and manufacturing process assure greater dimensional accuracy, true circular cross sections and uniform wall thickness not less than the nominal pipe wall thickness.

Midwest Ells have great strength. In a series of destruction tests to compare the strength of Midwest Ells with the pipe with which they are used, the pipe ruptured in each instance while there was no evidence of failure in any of the Ells.

• • •

Midwest Welding Ells are made from the same material as mild steel pipe; standard weight are in stock from 2″ to 16″, and extra heavy from 2″ to 12″. They are also made from Reading Puddled Iron; sizes at present are 2″ to 10″ in both standard and extra heavy weight.

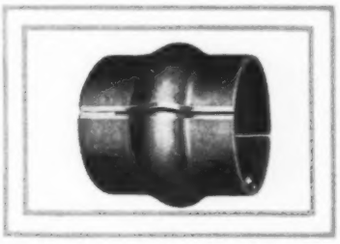
Ask the nearest Midwest office for a copy of Bulletin WF-2 which contains complete data on Midwest Ells and the other Midwest Welding Fittings at the right.

Here are other Midwest Welding Fittings that also help reduce the cost and improve the design of many types of piping systems.

MIDWEST WELDING HEAD

The ellipsoidal form reduces unit stress in the metal to a minimum. The long tangent puts the circumferential weld to the pipe entirely in tension —it is not subjected to shear and bending. Application is much easier and a neat appearing job is assured. Standard weight and extra heavy Heads carried in stock from 3″ to 24″.

MIDWEST WELDING SLEEVE



Used to reinforce a butt line weld between two pieces of pipe, it relieves the butt weld of any bending stress and much of the tensile stress to which it would otherwise be subjected. Transverse recess in sleeve permits its application over the conventional butt line weld. Sleeves are carried in stock from 4″ to 24″.

MIDWEST WELDING SADDLE

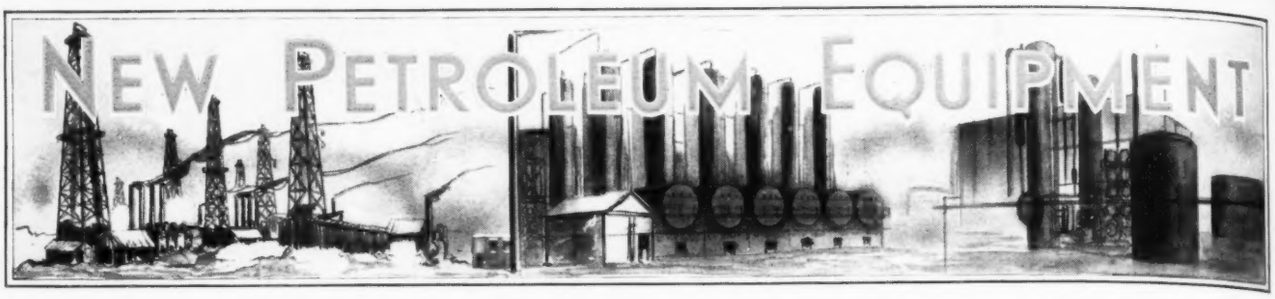
It not only reinforces the junction of neck and body of a welded header, but also compensates for the weakening of header body that results from loss of the metal cut out for the neck opening. Tests proved this saddle materially increases the strength of a welded header over customary gusset plate construction. Made in sizes from 4″ x 2″ to 24″ x 24″.

Midwest Piping & Supply Co., Inc.

Main Office: 1450 South Second St., St. Louis

Offices: Chicago, 208 South La Salle Street . . . Houston, 600 Bringhurst Street . . . Los Angeles, 520 Anderson Street . . . New York (Ballwood Division), 30 Church Street . . . Tulsa, 733 Mayo Building

THE GREATER MIDWEST PIPING SERVICE



W-K-M Pipe Cradle

THE W-K-M Company, Inc., Houston, Texas, is offering in the W-K-M Pipe Cradle, a time and labor-saving device, which according to the makers, represents a worthwhile advancement in pipe line construction methods.

A few of its many uses include (1) the lowering of lines in the ditch, (2) the removal of old lines from the ditch, (3) the raising and holding of pipe at the proper level for cleaning, coating and wrapping.

The three sets of steel cone rollers operate on bronze bushings equipped with Alemite fittings for convenient lubrication, and are assembled into heavy side bars which are hinged in the middle in order that it will move over collars and welds without jumping.

Logarithmic Chart of Viscosities

THE Visco-Meter Corporation, Buffalo, New York, announces the completion of an entirely new logarithmic chart of viscosities. It is said this chart saves considerable time and calculating by means of its instantaneous indication S. A. E. rating of any oil plotted. It also provides a simple determination of viscosity at important temperatures for both lubricating and fuel oils.

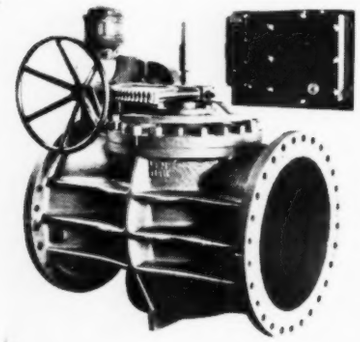
The chart measures 26 inches by 29 inches and its ranges are as follows: (a) Universal Saybolt, from 40 to 200,000 seconds; (b) Fahrenheit temperature, from —20 degrees to 330 degrees; (c) Centigrade temperature, from —30 degrees to 166 degrees; (d) Furol Saybolt, from 30 to 20,000 seconds. There is a table of Redwood at Engler multipliers for the range of the chart.

The features of interest for this particular chart are that its size and accuracy make it possible to have a line graduation for every second of viscosity from 40 to 100 Saybolt, a line for every two seconds from 100 to 200 Saybolt, etc. For convenience and speed of use, every section of graduations using a certain viscosity interval per space is labeled so that the viscosity interval can be had at a glance.

These charts are now available at the nominal charge of 50 cents per chart. Details may be obtained from the Visco-Meter Corp., 315 Grote Street, Buffalo, N. Y.

Remote Control Equipment for Large Valves

ELECTRICALLY modernized and remote control equipment for use in the operation of large size valves has been developed by the manufacturers of Nordstrom Valves.



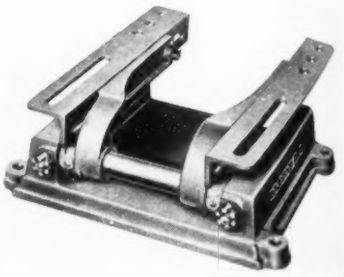
These plug cock type lubricated valves up to 30 inches in size can be manually operated or by use of a low-gear small motor. A remote control box has been developed for operation of the valve. The equipment of several different electrical manufacturers can be used, according to the valve manufacturers. Merco Nordstrom Valve Company, San Francisco, Calif.

The control system can be set in control houses or in the central operation office distant from the actual location of the valve, and by means of these controls the valves in the different lines can be manipulated. The quarter turn and lubricating features in Nordstrom valves make them particularly adaptable to remote control systems.

Engineers of the company also report the development of steam jacketed valves suitable for use in steam jacketed piping for handling fluids, for which all-iron valves are satisfactory.

Adjustable Arm Rockwood Drive Bases

THE Rockwood Manufacturing Company, Indianapolis, Ind., has brought out a newly designed Rockwood short center drive base equipped with adjustable arms and has increased the list of sizes so that stock drives from one to 100 horsepower are now available. The new bases now have a full range of adaptability to all types of motors and generators.



The new adjustable arm Rockwood drive bases have adjustable brackets or slide arms mounted on the pivoted angle iron arms with set screws. Adjustment for tracking of the belt can be made by moving one end only of the pivot shaft by means of the lead screws in the base.

The adjustable feature of these bases enables the motor to be so located that the belt tension is adjusted exactly to the load and motor requirements. After the drive is running the r. p. m. of the pulleys are checked and if belt has more than one per cent slippage the motor is moved a little farther back—until slippage stops. If the belt does not slip, but the motor is running too warm, showing too much strain on the motor bearing, the motor is moved forward and the bearing strain on the motor bearing made normal.

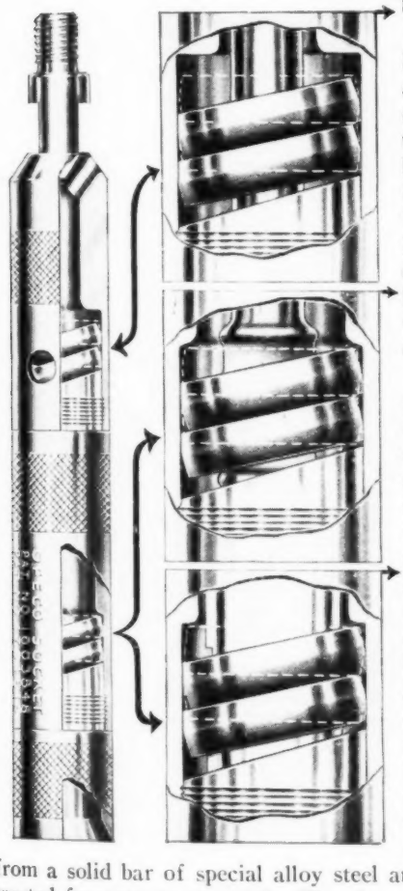
Midwest Welding Saddle

MIDWEST PIPING AND SUPPLY COMPANY, INC., has developed the Midwest welding saddle for use as a reinforcement at the junction of the neck and body of a welded header. The neck is welded to the body in the usual manner; this weld is primarily for tightness. The saddle is slipped down the neck until it fits snugly against the body; it is then welded into place with a heavy bead. The saddle is not for tightness—it relieves the weld between neck and body of the greater part of the tensile, bending and shearing stresses to which it would otherwise be subjected.

These saddles are made to fit welded headers of several standard sizes, including four-inch, six-inch, eight-inch, 10-inch, 12-inch, 14-inch, 16-inch, 18-inch, 20-inch and 24-inch headers. Thickness will be varied by the manufacturers to suit the pressures and service for which the headers are intended.

Additional information on the Midwest welding saddle may be obtained from the company at St. Louis, Mo.

Ofeco Rod Sockets



THE Ofeco rod socket for fishing sucker rods is a new piece of equipment offered to the trade by Oil Field Engineering Corporation, Fort Worth, Texas. It is said to be capable of catching badly worn rods as well as full sized ones.

According to the makers, the Ofeco rod sockets have the unusual features of having no slips, tapers or springs. There is no pressure on the sides of the shell and no possibility of splitting or bulging the bowl as all strains are taken in the same direction of the pull by the rings and canted surface of the guide. The socket is machined from a solid bar of special alloy steel and electrically heat-treated for extreme strength. The rings are machined from a fine grade tool steel electrically heat-treated.

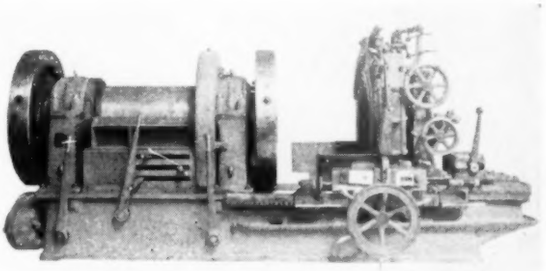
There are three sets of rings furnished with each Ofeco combination rod socket, one set to grip the rod, one set for the coupling and the other for the upset. The top set of rings is always the rod rings, the bottom set of rings grip the upset or coupling. If the break is on top of the coupling the coupling rings are used, if on the bottom of the coupling the upset rings are used.

Landis 13⅜-Inch Pipe Threading and Cutting Machine

THE Landis Machine Company, Inc., at Waynesboro, Pa., has added another pipe threading and cutting machine with receding chaser die head and lead screw to its line of pipe machines.

This machine, known as the 13⅜-inch size, has a capacity of 4½-inch to 13⅜-inch O. D. It will make a tapered pipe thread of any length up to and including 8-inch and any tapers of ¾-inch per foot and less on all pipe, casing and tubing sizes within its range.

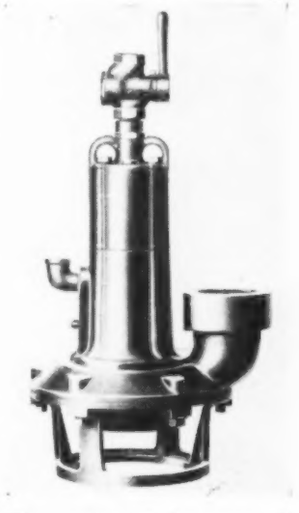
According to the makers the receding chaser feature reduces the cutting strain on the chasers to that required for a straight thread of like diameter and pitch and insures super accuracy and an exceptional finish. It also permits the use of a very narrow chaser which lowers the initial chaser cost, adds materially to the life of the chasers between grindings and otherwise effects a saving, the makers state.



The die head has a universal adjustment for size. In addition there is a micrometer adjustment for the final setting. The die head is a two-cut head and can be used for roughing and finishing.

Cleco-Deming Centrifugal Sump Pump

A NEW centrifugal sump pump, the Cleco-Deming pump, has been produced by the Cleveland Pneumatic Tool Co., of Cleveland, Ohio. It is designed for general contracting work such as pipe jobs, ditch and trench digging, and for building foundations and structures.



Production of the pump involves collaboration of the Deming Pump Co., of Salem, Ohio, which supplies the pump and the Cleveland Pneumatic Tool Co., which provides the motor and will merchandise the unit.

The Cleco-Deming pump is adapted for service wherever liquids accumulate and compressed air is available and has the operating power unit integral with the pump housing, making a portable outfit easily handled by one man, as it only weighs 36 pounds. The motor of the pump is operated by compressed air and is automatically lubricated from a reservoir located in the cylinder body.

Hydrauger Corporation Boring Machine

DEVELOPMENT of an improved tool that permits boring under a street without interference of traffic, is announced by the Hydrauger Corporation, of San Francisco, Calif. Increasing traffic problems have made necessary the development of this product.

It is a compact unit driven by compressed air and connected with running water. The unit is comprised of an auger which can be placed in a trench. Compressed air operates the auger and the circulation of water washes the borings back as fast as they are cut. The feed ahead is accomplished by a reversible ratchet. As boring in the hole is completed to its desired diameter, the permanent pipe can be pushed in either by hand or by the aid of the ratchet on the Hydrauger.

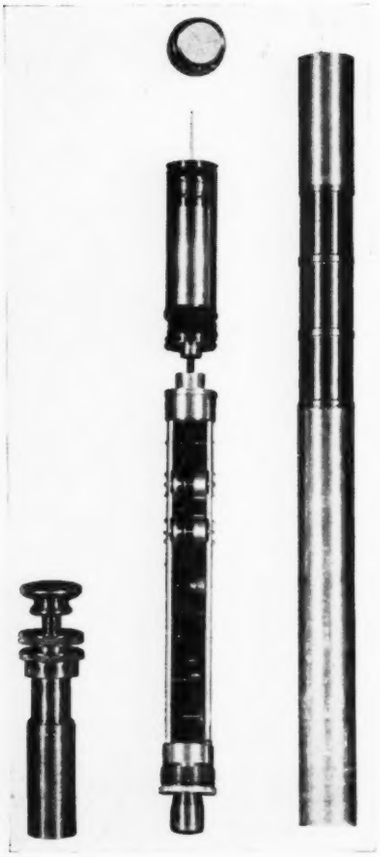
The Hydrauger is made in two sizes—2½ and 5-inch—and with the use of a reamer attachment the size of hole can be approximately doubled. Maximum boring speed in feet per minute, including insertion of boring-bar lengths, is one-half to two feet.

Air pressure of 85 pounds is required and the consumption of air per cubic foot per minute for the 2½-inch size is 54 pounds and for the 5-inch size is 80 pounds. The desirable water pressure in pounds per square inch ranges from 75 to 100 cubic feet and much less pressure can be used satisfactorily.

The length of the smaller machine is seven feet, three inches and the larger machine 10 feet, three inches; and the weight of the 2½-inch machine is 260 pounds; the five-inch machine 410 pounds.

Literature describing the machine in detail may be obtained by addressing the Hydrauger Corporation, 1298 Bryant St., San Francisco, Calif.

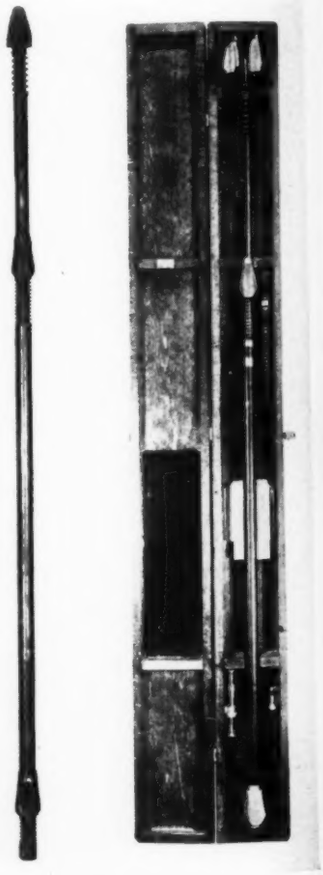
Totco Drift Recorder



THE Totco drift recorder, a recently introduced instrument for recording hole deviation from vertical, is the result of more than two years of intensive development and research work on the part of the engineers of The Technical Oil Tool Corporation with the co-operation of two large California oil companies.

In running a Totco recorder, a new chart is placed in the chart holder plug, the setting device is then turned to the time that the instrument is desired to make its record. The next step is to push the setting device down the instrument and then pull it out, which action starts the timing mechanism in motion. This causes a needle to punch a hole in the chart disc at the exact time the setting device has been set for. Then a chart holder plug is screwed into the body of the instrument when it is placed into the "go-devil" body; the lock plug is screwed into the "go-devil" body and the recorder is ready to be dropped into the drill pipe.

The standard Totco drift recorder is furnished with recording discs which read to 10 degrees. A special attachment can be furnished to read as high in degrees as required, for unusual conditions. Additional details may be had by addressing the Technical Oil Tool Corporation, Ltd., 350 South Bristol Ave., West Los Angeles, Calif.



READY
at the First Strike

YOUR ever-ready servant—this gigantic supplier of tanks and accessories typifies Parkersburg's field resources. He covers all the principal fields in the Mid-Continent and Gulf Coast districts—ever watchful, ever equipped to give you prompt, faithful service.

Especially in the matter of urgent delivery of Tanks, you will appreciate Parkersburg's dependable quality and complete facilities which extend wherever oil is produced. Ample stocks and able erection crews are ready at your nearest distributing centers for speedy service and greatest economy.

Of course you want vapor-tight tanks to save evaporation losses. Parkersburg vapor-pressure fittings do this efficiently, automatically. The Pressure Relief Valve, built to retain pressures up to 16 ounces, reduces breathing and saves the valuable light ends of the crude. The Vacuum Valve with Swing Check adjusts the amount of air to conform with atmospheric changes and to relieve vacuum created when tank is emptied.

Parkersburg Bolted Tanks of Corrosion-resisting, Copper-bearing Steel are known for their accurate fabrication which makes them easy to erect—portable. Furnished with a heavy coating of aluminum in sizes ranging from 30 to 10,000 barrels.

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CABLE ADDRESS "PARIGREEL"

Promal Malleable Iron

PROMAL, a specially processed malleable iron, which for four years has been made by Link-Belt Company, Chicago, Ill., and used exclusively for its own chain products, is today finding a demand from manufacturers of other equipment.

Promal can be repeatedly heated to a maximum of 1000 degrees F. and cooled without affecting its physical properties, which makes it a desirable material for use on low-temperature heat-treating equipment, or for parts which are to be hot-dip galvanized.

The physical properties of Promal are:

Yield point	50,000 lbs. per sq. inch
Ultimate strength	70,000 lbs. per sq. inch
Fatigue strength	33,000 lbs. per sq. in.
Elongation	10 to 14% in 2-inches
Modulus of Elasticity	26,000,000
Coefficient of thermal expansion	.0000109 inches
Electrical conductivity	211 ohms per mil. ft.
Magnetic permeability	79 to 200 ampere turns
Specific gravity	7.35
Average Brinell hardness	170 to 190

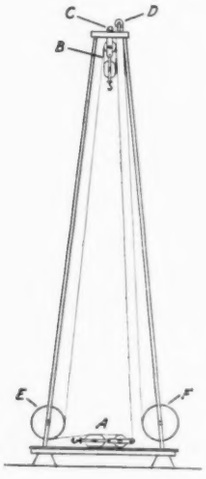
Copper bearing Promal can be readily supplied where exceptional corrosion resistant properties are desired. By the addition of suitable alloying elements, Promal can be supplied with exceptionally high physical properties and wear values.

The Link-Belt Company will be glad to furnish additional information on uses for Promal metal to anyone interested.

The Jiffy Safety Crown Block

THE Jiffy Safety Crown Block is designed to reeve the drilling line in a jiffy and in safety, according to Oscar Bieler, Pittsburgh, Pa., its manufacturer.

The main feature of this block is its method of suspension, it being suspended by a single removable pin, known as the king pin. Both the crown block and traveling block are reeved on the derrick floor, permitting every member of the drilling crew to take part in the operation.

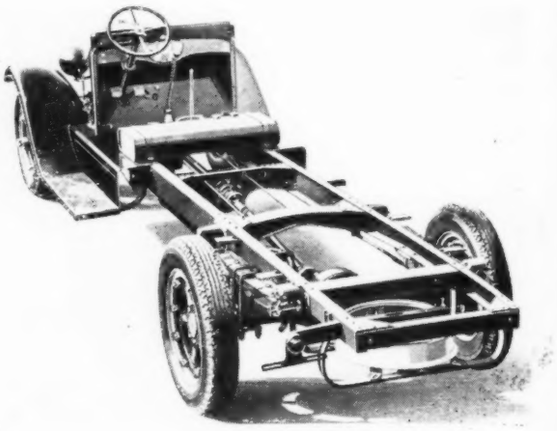


Reference A on the sketch shows both blocks on the rig floor during reeving operations. Reference B shows the blocks hoisted to the top of the derrick, with the king pin, C, in place. Reference D is a sheave on the crown block base used when the blocks are hoisted to the top of the derrick. Reference E is to the calf wheel or auxiliary hoist, and reference F is the rotary hoist.

The line is reeved by pulling the free end over the top of the derrick, over sheave D, and down to the derrick floor, and then reeved through both blocks on the floor. After which it is dead ended on the calf wheel with sufficient line wound on same, so that when both blocks are hoisted, the dead end will still be on the hoist. In case a calf wheel or hoist is not used, the line is dead ended on the derrick corner post, and enough line pulled through to equal the amount which would have been wound on the calf wheel. The line is now clamped to the clamping device at the crown block, both blocks hoisted to the top of the derrick, the king pin put in place and the line unclamped, taken off the hoisting sheave, a strain taken on the line and the top clevis of the traveling block removed from the hook on the bottom of the crown block and hoisting operations are ready to commence in the regular manner.

International Harvester 6-Cylinder, 1½-Ton Truck

ANNOUNCEMENT has just been made of the new International Harvester Model A-3, 6-cylinder, 1½-ton truck, with 136-inch wheelbase chassis. The Model A-3 is also available in 160-inch wheelbase at slightly higher cost.

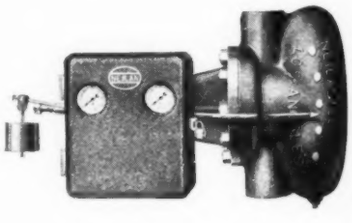


The engine which powers this new model is of the detachable L-head type; 3¼-inch bore by 4½-inch stroke. Its piston displacement is 224 cubic inches. The engine develops a maximum brake horsepower of 54 at 2700 revolutions per minute. Its maximum torque is 138-pound feet at 700 to 900 revolutions per minute. The clutch is of the single-plate type with built-in, vibration damper, while the transmission provides four speeds forward and one reverse speed.

The frame is made of heavy pressed steel channels, seven inches deep at the center and reinforced with numerous cross members which assure rigidity with ample flexibility to meet varying load and road conditions. The front and rear springs are of the semi-elliptic type and semi-elliptic auxiliary rear springs are also provided. The rear axle is of the full-floating, spiral-bevel-gear type with axle shafts of chrome-molybdenum steel.

New Liquid Level Controller

THE first instrument type liquid level controller is now being marketed by the Neilan Co., division of Mason Regulator Co., Los Angeles, Calif. This controller has been developed for the express purpose of controlling the levels of liquids of high gravities. It is also finding a wide application for interface service where the float is required to sink in one liquid and float in another of a different specific gravity.



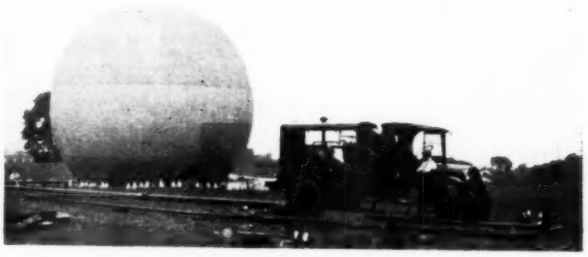
Through the sensitiveness and other refinements of this new Neilan controller only a six-inch float is required to provide ample power for maintaining levels in liquids of even the highest gravities. This instrument is of the pilot operated type and may be used to operate a remotely located control valve.

Balloons Supply Gas to Town While Line Is Repaired

THE use of two 35,000 cubic foot standard aviation racing balloons as emergency storage containers recently enabled The East Ohio Gas Company to give its customers in the town of Ravenna, Ohio, uninterrupted service while replacing the only gas line into the town. This interesting and novel feat was quite satisfactory and, so far as determinable, is the first time that balloons have been used for the purpose of an emergency gas supply system.

The town of Ravenna is supplied with gas through one 8-inch trunk line, this being the only feed into the town. It became necessary to renew four sections of the line, which were at various points between the border reducing valve and the next main line gate some eight miles away. The sections which were to be renewed were laid dead close to the live line and all things made ready for a quick tie-in.

The trunk or main line carries from 125 pounds to 200 pounds pressure up to the reducing valve. A high-pressure tap was made on the low side or city high-pressure side of the reducing valve which cuts the pressure to 30 pounds. A three-inch line was run from this point to a nearby field and a manifold of three- and six-inch pipe was built in the shape of a "Y". The balloons were direct connected in this manner to the city high-pressure line and were filled



Inflated balloon with portable compressor unit in foreground. Note by-pass around compressor.

by by-passing a portable compressor unit that had been connected to one of the balloons.

The balloons were obtained from the Goodyear Tire and Rubber Company and were inflated under the supervision of the Goodyear factory personnel in charge of J. F. Cooper. When the balloons were filled, and after a short test run, the gates at the reducing valve and the one eight miles away were closed and the trunk line was blown down. The new sections were tied in and the line put back into commission in a little over one hour's time.

The portable compressor unit, mounted on a truck, was a standard 220 cubic feet per minute capacity air compressor which required only a few minor changes for this work. Gas was pumped from one balloon at a time and passed through the compressor into the main line. In this way the consumers of Ravenna were safeguarded against any decrease in their gas supply or even in the pressure of the gas.

Note the bubble which accurately shows both direction and degree of inclination.

Now You Can SEE Inside Your Well

EVERY well, either abandoned or costly in operation should be "looked into". Pumping costs depend upon more than depth; upon crookedness of the drill-hole. Fortunes in oil have been missed by deviation.

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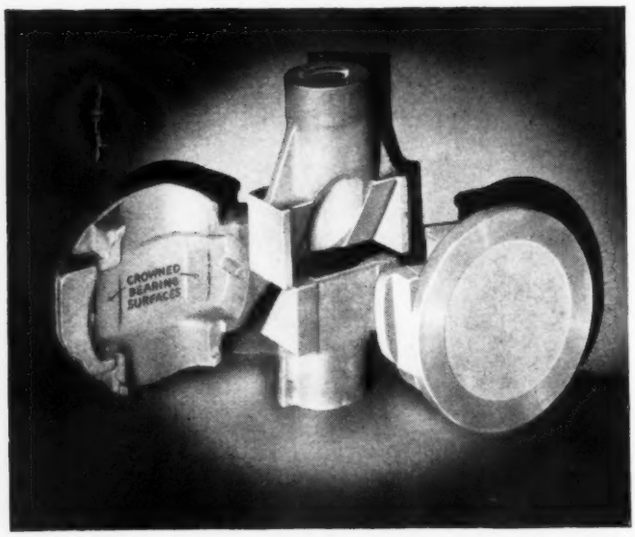
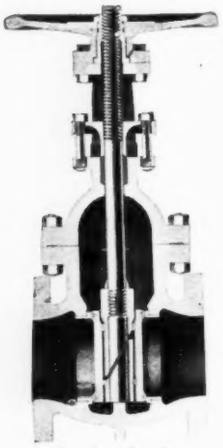


Above: View showing the upper and lower spreaders and the two discs comprising the closing mechanism. Note the two crowned bearing surfaces which are located on the back of each disc.

opens wide and close tight



Sectional view, Fig. 879.

THIS new Jenkins Iron Body Doub'e Disc Parallel Seat Gate Valve will not stick because the two parallel discs make a smooth, clean and perfectly uniform contact with the seat rings in the body. The pressure exerted by the spreaders is distributed between the discs uniformly, due to the correct size and accurate location of the two crowned bearing surfaces on each disc.

The two inter-acting wedge-shaped spreaders do not exert pressure against the discs until the base of the lower spreader makes contact in bottom of body in the final c'osed position. In opening the discs do not start to leave the seat rings until spreader pressure is relieved between them. This assures easy opening and closing and contributes to lasting performance. Write for Form 143, giving details.

Jenkins Valves are always marked with the "Diamond"

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Well Pumping P
Given Intensi

WELL pumping technique, especially as it applies to deep oil wells, has become a highly specialized phase of oil producing operations. More study is being given to the economical pumping of wells today than at any time in the past. To the engineer and the field superintendent it is proving a fertile field for effecting economies in these times of low crude prices and curtailed production. Every cent that the lifting cost per barrel is reduced means an increase in the economic life of the field, an item the importance of which is frequently overlooked.

With the exception of the development of the gas-lift, which had its period of most rapid advancement and successful application during the development of the Seminole field, methods of lifting oil to the surface from wells after they have ceased to produce by natural flow have undergone comparatively little change. Considering the progress that has been made in the producing branch of the oil industry in general this may seem a surprising statement. It brings into relief the fact that despite the rapid increase in well depths and the dire predictions that the limits of pumping depths would soon be reached, pumping is still the dominant method of producing oil after the period of natural flow has passed.

While the principles and practice of present day pumping methods of producing wells on the beam or by jack are an outgrowth of the crude methods of the very early days, the fact that they have not changed much can be accounted for in large part to the many refinements in the design and construction of pumping equipment and improvement in the grade of materials to meet the ever-increasing severity of service that modern oilfield operations demand. So long as wells are relatively shallow the need for extreme care in the choice and operation of equipment in order to effect economies has not been so obvious. Today things are changed. When a well 6,000 feet or more deep has to be placed on the pump the selection of equipment that has adequate strength and will do the job most efficiently and economically must be based on sound engineering data and experience.

Slip-shod methods of pumping wells are gradually disappearing. Just as soon as a well is p'aced on the pump the real work of effecting economies in operation begins. The well is usually weighed with a dynamometer and the counterbalance set so that stresses in the sucker rods and on surface equipment are reduced to a reasonable minimum best suited to the well conditions. A study of the dynamometer cards reveals improper operation of the pump and defects in adjustment of surface equipment in a way that cannot be detected by ordinary methods of observation. Remedial measures, if necessary, are taken and adjustments made that resu't in marked reduction of power costs. A reduction in wear and tear of equipment is also a usual concomitant resulting from such procedure. It is field investigations of this nature that have furnished valuable information and suggested changes in design and construction of equipment to improve the efficiency of operation. Before well adjustments were made in this manner there was no way of obtaining reliable data regarding many fea-

Problems Being ensive Study

tures of well pumping operations that were obscure or intangible.

Positive evidence of the destructive effects on sucker rods, and on well equipment as a result of the misalignment of surface equipment and loose, worn bearings has been obtained by close well observation. This emphasizes the need for keeping all surface equipment tight and in good alignment. Trouble from this source is now considered inexcusable. Rig fronts of improved design have contributed to the elimination of such troubles.

The use of insert type pumps is finding favor for deep wells whose daily rate of production is not too high. The smaller cross sectional area of the pump has been an effective factor in reducing sucker rod stresses. Another advantageous feature is a reduction in the number of tubing jobs. These are time consuming and expensive jobs in deep wells. One company in the Mid-Continent reports a substantial saving in tubing replacements as a result of the use of insert type pump, due to a decrease in the number of tubing jobs. Records show that high volumetric efficiencies are obtained.

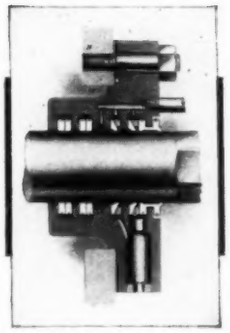
Wells of close to 4,000 feet in depth are being pumped today by individual jack pumping units. Beam wells are being pumped from depths of almost 8,000 feet. These are remarkable pumping depths and are a demonstration of the progress that has been made in the adaptability of present day pumping equipment.

Prime movers have had little trouble in meeting the field pumping conditions. All gas engines, oil engines and electric motors have been keeping pace with the well pumping requirements and there is evidence that the success of these has played no small part in overcoming problems of deep well pumping. Reduction gear units have been developed to a high degree of efficiency for deep well pumping duty. These are of various types and can be had to be adapted to almost any desired type of drive.

A recent accessory of interest to aid in the diagnosis of actual conditions at the bottom of the well while the well is in operation is the bottom-hole pressure recording gage. Information obtained by this instrument will add to our too meagre knowledge of conditions at the bottom of the hole and supplement observations taken at the surface on pump operation.

As our fund of knowledge regarding well pumping conditions increases many fallacious ideas at present held on pumping wells will no doubt be discarded.

Regardless of the fact that great strides have been made in developing improved methods of well control by conserving gas energy and prolonging the life of the well, and in other methods for increasing recovery, the problems incident to the pumping of deep wells are being attacked in vigorous fashion and with remarkable success; such success indeed, that pumping both deep and shallow wells is likely to continue to be in the forefront of good economical practice. What will be the limit of pumping depth must remain a matter of conjecture for still some time to come.



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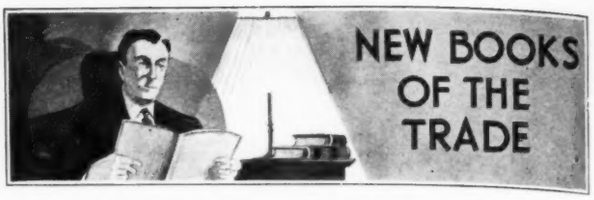

OXY-ACETYLENE WELDING AND CUTTING is the title of a fine new book by Stuart Plumley, chief engineer, Smith Welding Equipment Corporation, Minneapolis, Minn. This 400-page book is a course of instruction in oxy-acetylene welding and cutting and is so arranged that each lesson is a job sheet, describing the specific work which the student is expected to do as practice work with the torch.

WAGNER ELECTRIC COMPANY, St. Louis, Mo., has published a new 30-page bulletin on "Small Motors." The bulletin is divided into eight parts describing single-phase, polyphase, and direct-current motors in fractional-horsepower ratings. The new bulletin is known as No. 167, and is loose-leaf form to permit keeping it up-to-date.

A NEW CATALOG featuring a number of improved types of oil burners has been published by Enterprise Oil Burner Company, San Francisco, Calif. The catalog contains 32 pages, presenting complete illustrations and details of the burners, with specifications and data on fuel consumption and vital heating statistics.

PODBIELNIAK ANALYTICAL AND RESEARCH LABORATORIES, Tulsa, Okla., has published two new circulars. Circular No. 4 announces the Podbielniak standard precision apparatus Model-A for low-temperature fractional distillation analysis, the radically new type Podbielniak Thermos containers, standard gas and gasoline sample containers, and the special packless and leakproof sample container valves. Circular No. 7 describes the new Podbielniak high-temperature fractional distillation analysis apparatus.

THE BASTIAN-BLESSING COMPANY, Chicago, Ill., makers of Rego Welding and Cutting Equipment, announces the completion of a new Catalog No. 57. It is of pocket size and indexed for ready reference. It lists specifications and prices of all types of welding and cutting equipment manufactured by the company.

"MORE ABOUT CERTIFIED BLACK" is the title of a new booklet published by Godfrey L. Cabot, Inc., Boston, Mass., in which the recent progress of this company's chemists in improving the technical control of the quality of its production is discussed. The booklet, covering 24 pages, is well prepared and well printed.

NEILAN CO., Ltd., Los Angeles, Calif., now a division of Mason Regulator Company, has published a new bulletin describing the company's new non-recording temperature controller. The many technical advancements of the controller makes the bulletin of interest to those requiring temperature controller equipment.

THE ELECTRIC CONTROLLER & MANUFACTURING COMPANY, Cleveland, Ohio, has published a new bulletin on equipping of automatic pumps with automatic control. One or more pumps can be automatically started and stopped to maintain a liquid-level or pressure within extremely close limits by this ultra-sensitive system of control.

THE OPERATOR'S STABILIZER, published in the interest of the welding operator by The Lincoln Electric Company, Cleveland, Ohio, is a very interesting and helpful magazine. The December-January copy has just been published, and like other issues, contains many articles and suggestions that all welders should find beneficial to them in their work.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has published bulletin No. GEQ-841B, which supersedes GEA-841A. This bulletin describes the company's CR7006-D40 Magnetic Switch, which is suitable for throwing small alternating-current motors directly across the line. Two other recent bulletins of the company are: GEA-1236A, which is devoted to G-E Fabroil Gears and Gear Blanks, and GEA-1242A in which G-E Textolite Gears and Gear Blanks are discussed and pictured.

WINTON DIESEL ENGINES, stationary and industrial types, is the subject of a new booklet being distributed by Winton Engine Corporation, Cleveland, Ohio. The booklet presents specifications and illustrations of engines ranging in size from 45 horsepower to 1200 horsepower.

GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has published catalog No. GEA-606C, which supersedes catalog No. GEA-606B. This catalog furnishes information on representative lines of industrial control equipment manufactured by the company. It also includes instructive matter on the care and operation of control devices, wiring diagrams of standard controllers, push buttons and other accessories; reference tables; list of publications, and other useful information.

PITTSBURGH PIPING CREASED BENDS for Pipe Line Construction is the title of a pamphlet issued by the Pittsburgh Piping & Equipment Co., of Pittsburgh, Pa. Illustrations and a discussion of the recent development of creased bends is found in the booklet.

CRANE CO., 836 S. Michigan Ave., Chicago, Ill., is distributing to the trade Circular No. 243, covering large flow pressure double disc gate valves. The company's complete line of this type valves is pictured and in addition much helpful data are included.

SEMET-SOLVAY PIPING AND VALVES is the latest bulletin published by the Semet-Solvay Engineering Corporation of New York City. This bulletin, No. 44, covers the company's complete line of piping and valves and has many tables and suggestions for applications.

UNIVERSAL HERRINGBONE GEARED RIG FRONT for cable tool drilling and pumping, manufactured by Lufkin Foundry & Machine Co., Lufkin, Texas, is described in Bulletin 81 just off the press. It may be obtained by writing to the Lufkin company.

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This Balancing feature insures full-floating action of the diaphragm valve, entirely eliminates over-control tendencies and "hunting". It is achieved without complicated, trouble-inviting capillary spools, internal or external capacity tanks and fixed-lag arrangements. This latest TAG development furnishes 100% automatic control by its ability to maintain the diaphragm valve opening at the required demand point over the full range of valve opening. It also permits the operator to change his setting point anywhere within the range of the controller without fear that the controller will "go into a swing".

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. . . For use in the Pictorial Petroleum Section, The Petroleum Engineer desires unusual and interesting photographs. These may be of field scenes, new installations, new hook-ups, individuals, or any subjects likely to appeal to men in the petroleum industry. Especially do we want pictures of "old-timers" who are still active in the business and views with a foreign setting.

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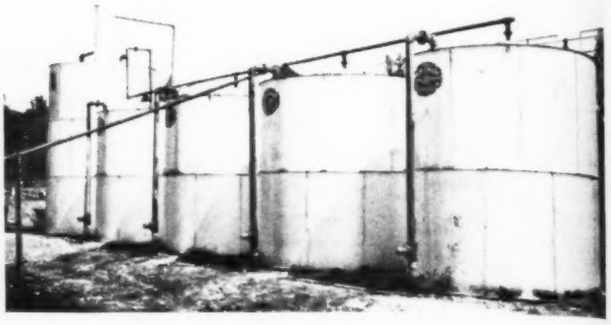
Flume Tanks and Separators

ENGINEERS of the Columbian Steel Tank Company, Kansas City, Mo., have developed a flume tank and separator to remove casing head gas as it flows into the storage tanks. A good number of these are already installed in the East Texas fields; in many of these installations the flume tank and separator are added after the remainder of the battery is in place.

In operation the oil flows from the usual trap separator into a flume cylinder near the top where it splashes down



through the cylinder over baffle plates. This releases the remainder of the gas which goes to the extreme top, where it is pumped away under strong vacuum pressure. This effectively prevents accumulation of gas in the main battery of storage tanks and greatly diminishes the fire hazard.

The gas may be piped away to a safe distance and allowed to escape through pipes extended high into the air, or may be used to supply refineries or natural gasoline plants.

Haystellite Composite Rods

THE Haynes Stellite Company, Kokomo, Indiana, has developed a special hard-facing rod for oil-well drilling tools. This product is known as Haystellite Composite Rod, and application has been made for United States patents.

This product consists of various screen sizes of sharp, irregular shaped grains of Haystellite, a cast tungsten carbide, uniformly distributed in a binding material.

Crushed Haystellite of screen sizes 4 on 8, 8 on 16, 10 on 20 and 20 on 30, and three types of binding materials—Haynes Stellite, Hascrome and High Test Steel are used. The list, which comprises ten standard rods, includes practically every screen size of tungsten carbide and type of binding material required for facing the various types of drilling tools and for the efficient drilling of the various formations.

The three types of binding materials employed cover a range from the most wear-resistant to the toughest and strongest alloys. The rod in which the most wear-resistant alloy, Haynes Stellite, is used as a binding material, results in a slow and uniform wear and projection of the grains of Haystellite, while the High Test steel binder results in rapid wear of the steel base between the grains of Haystellite and, therefore, a more pronounced projection of each grain.

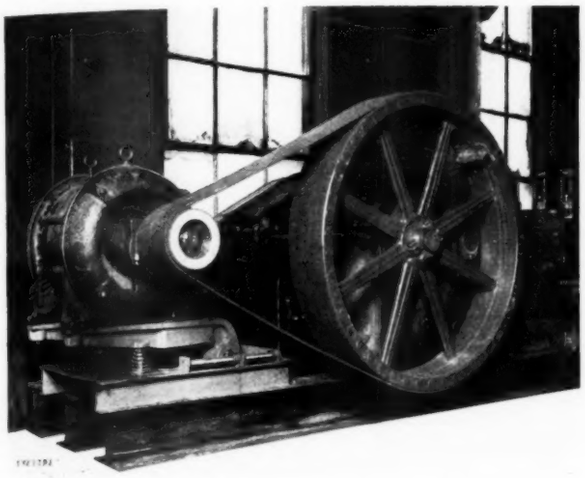
It is recommended that these rods be applied to the cutting edges of oil well drilling tools with the oxy-acetylene blowpipe, although the electric arc method can be used when necessary.

Detailed information in regard to this product can be secured by writing to the Haynes Stellite Company at Kokomo, Indiana, or to the nearest of their District Sales Offices, which are located in Chicago, Cleveland, Detroit, Houston, Los Angeles, New York, San Francisco and Tulsa.

New Short Center Belt Drive

A NEW short center drive using flat belting and flat pulleys that is causing considerable interest is the Rockwood Drive manufactured by the Rockwood Manufacturing Company with the leading manufacturers of leather belting co-operating. It is attracting attention from men interested in standard compressor and pumping drives from the production and refining division of the industry.

The motor is mounted on two arms or brackets which in turn are mounted on a pivoted shaft anchored on two adjustable screws in the base. Part of the weight of the motor is utilized to maintain a prescribed tension in the belt, which tension is thus maintained uniform and constant at all speeds.



Rockwood Drive on large hydraulic pump. Motor 60 h.p., pulley ratio 5 to 1; distance between pulley centers 50 inches; belt speed 4,396 r.p.m. As the weight of the motor is utilized to maintain a uniform tension in a belt of known characteristics the drive is as correct in its mathematics for large as well as small motors.

The friction of a leather belt of great load capacity operating over a paper pulley is very high; the drive operates with a ratio of 9 to 1 between tight and loose sides. Each drive is designed to have an overload capacity of 150 per cent of the motor rating for standard drives and for heavy duty drives in field work the overload capacities are much greater.

As the action of the motor on the pivoted base automatically takes up all belt stretch the belt has rarely to be touched after it is installed.

Several thousands of these drives are in operation in other industries, the first experimental drives were made seven years ago. Engineers of the leather belting industry have been co-operating with the engineers of the Rockwood Company for the last two years and the resultant finished drive was placed on the market this spring.

Another interesting feature of this drive is that with tension maintenance the leather belt can operate at much higher speeds, even as high as 7,000 feet per minute.

The drive is listed and stocked in many cities in sizes up to 50 horsepower, 1,800 r. p. m. Only six sizes of bases are required for all motors from 1 to 50 horsepower. The drive can handle very large motors, many from 100 to 150 horsepower.

The overload capacities, convenience and possible savings are of special interest to petroleum engineers. The belts are all in accord with the A. P. I. specifications for leather belts.

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(2-Cup Inserted)

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Developments *in the* Application *of*

Totally enclosed motors in a Texas Panhandle refinery.

By

T. D. WILLIAMSON

THE refining branch of the oil industry was the first to adopt electric power on a large scale. Its original uses were principally the driving of pumps and air compressors by electric motors as well as in the light systems.

The history of the refining industry has been one of continually changing methods resulting in obsolescence of equipments due to new and improved products discovered by the refining engineers; as well as the developments of new processes which effect reductions in production costs. Electricity has played a large part in these changing processes, and the manufacturers of electric equipment have endeavored in every way to co-operate in the advancement of this industry.

One of the larger and more progressive oil companies has designed and built a plant which might be termed a "Modern Ideal Refinery." The following is a brief summary of the most novel and interesting features which make this an unusual plant.

The pumps are installed out of doors, and as closely as possible to the refinery unit with which they are connected, thus effecting a saving in both installation and operating costs, in contrast with the installation of all pumps in one building. These savings are effected by shorter piping systems and reduced friction losses. The electric motors driving these pumps are of the weatherproof design, enabling them to be installed out of doors, without additional protection. The charging pumps are driven by special variable speed motors, having characteristics similar to steam pumps. These motors are protected from the weather by means of small "dog houses."

A control house, having windows on all sides, is installed between two rows of stills, in such a location that the operator may have a clear vision of all units. This control house contains panels having mounted on them all the recording and indicating instruments for the stills, fractionating towers, etc. Also, the push button controls for all motors are mounted on the front of these panels with the motor starting and protective switches on the back. Handles for all valves are installed in the control room. Thus, the attendant is informed at all times as to the operating conditions, and he may start or stop any pump or open and close any valve without leaving the building.

An important feature in this plant, from the standpoint of safety, is the method of electric installation. Since power is purchased, the transformer substation, to reduce the transmission voltage to that required by the motors, is located at one side of the refinery property, some distance from the stills. The power line, from the substation to the control house, is installed underground, and consists of lead-covered cable in galvanized conduit. The motor service lines from the control house to each of the pump motors are also installed underground, in galvanized iron conduit. Thus, all danger of fire, or to life by coming in contact with the electric wires is entirely eliminated. In contrast to this electric power system, we may visualize the amount of overhead piping which would be required, were steam pumps used.

The use of electricity also enables the most modern indicating, recording and control instruments to be utilized. Thus, in this control house temperature and pressure instruments are installed, operated from the power circuits.

The modern refinery just outlined, and which has been in operation for several years, has demonstrated that the use of electric power results in the following decided advantages over that of other sources of power:

(1) Reduced total investment in plant.
(2) Less shutdown time, due to fewer repairs.
(3) Increased production, because of more operating hours per year.
(4) Reduced cost of finished products because of:
    (a) Greater output per unit capacity.
    (b) Reduced investment cost.
    (c) Less labor required.
(5) Greater safety, both from standpoint of fire hazard, and danger to life.

Considering the many advantages contained in a refinery, utilizing electric power, as outlined above, it is safe to predict that in the design of new plants, as well as in the modernizing of present ones, many of these plans and systems of control will be adopted.

Within the past few years more thought than ever has been given to fire prevention in the design of refineries.

# of Electric Power *to* Refineries

This is partly due to the rules of the National Board of Fire Underwriters, establishing premium penalties unless equipments which meet their requirements are used. This rule resulted in the electric manufacturers designing a motor for "use in hazardous gas locations." These motors are so designed, that should an explosion take place on the inside, the frame will not break, nor will the flame be transmitted to the outside. In order that the complete installation be consistent, it was necessary for manufacturers of motor control equipments to redesign their devices, to meet the Underwriters' requirements. This has now been done, and motor controls, both air break and oil immersed types, are available from a number of manufacturers.

Within the past two years, considerable progress has been made by refiners in the manufacture of "cold test" lubricants. These improvements have required additional refrigerating machinery, usually driven by synchronous type motors. The most important consideration in the use of synchronous motors is with reference to the control equipment—that it should amply protect the motor, and perform the starting cycle, in the proper sequence. A summary of the important features of an ideal control is as follows:

(a) That the control be fully automatic—entirely removed from the human element—starting and stopping to be my means of push button stations.

(b) In case of "reduced voltage" starting, that the transition from "starting" to "running" always take place at a definite rotor speed, which has previously been determined.

(c) The direct current field, also, should be applied at a definite rotor speed, in order that the motor should not operate on the starting winding too long, and at the same time, the motor be given ample time in which to acquire as near synchronous speed as possible.

(d) The overload protective device should be thoroughly reliable and designed to function on a temperature basis—a basis which represents the operating conditions within the motor.

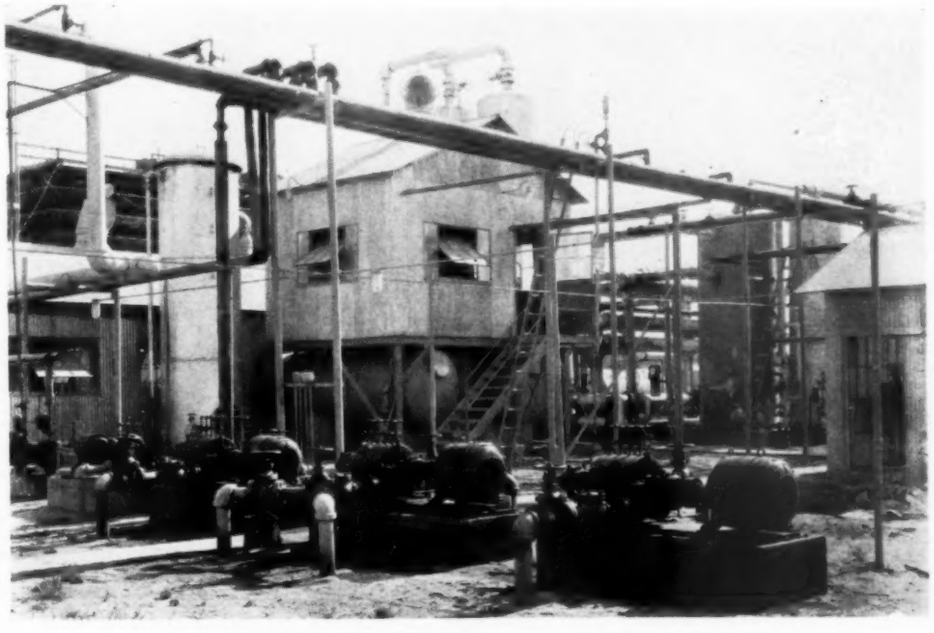
(e) In case of momentary power failure, the control equipment must be designed to remove the field excitation, and prevent interruption of the motor operation.

In order to make the starting of the refrigeration machine fully automatic, an unloading device, also automatic, is required. The development of an unloading device, which opens a bypass valve either at starting or during interrupted power service, is an outstanding achievement of a certain electrical manufacturer. This device closes the bypass valve when the synchronous motor has attained full speed, and is ready to carry the full load.

In the operation of certain pumps, refinery engineers, as a rule, require that variable speed be attainable, and that very fine adjustments be made. In the past this operation was obtainable only by means of steam pumps. Within the past few years, however, a manufacturer has developed a brush shifting type motor, by which very fine adjustments in speed are obtainable.

Some refinery engineers contend that fine adjustments in speed are not absolutely necessary in the operation of these pumps, and that variations in speed, in steps, within certain ranges, are entirely satisfactory. For this application multi-speed induction motors may be used. These speeds are arranged in steps such as 1800, 1200, 900 and 720 revolutions per minute, and combinations of two, three or four speeds, in all standard horsepower ratings are obtainable. The control for these multi-speed motors consists of a set of "across the line" contactors for each speed, controlled from a push button station. Thus, a four-speed motor would have four sets of contactors, on a panel, and four buttons, marked first, second, third and fourth speed, with an additional button for "stop".

In keeping with the safety developments of motor and control equipments, lighting units have now been designed to meet the Underwriters' requirements for use in "hazardous gas locations." Control switches are also manufactured to meet the same rigid requirements. Thus the entire electrical installation may be consistent. Lighting units for inside illumination should consist of a cast iron or steel body, heavy glass enclosing globe, guard and a steel enameled reflector. Body and glass globe should be of sufficient strength to withstand the shock of an explosion within the unit.

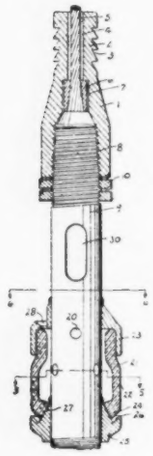


Electric motor installations in a natural gasoline plant.

Yard, tank and building exterior lighting should be accomplished by means of flood lighting units. The prime requisites in the selection of these units should be: (a) Non-tarnishable reflectors; (b) Strictly weatherproof enclosing case, which will not permit the entrance of insects; (c) Focusing adjustments, within required limits.

Keener competition, and smaller margins of profit require that refining companies hold both fixed charges and operating costs to the very minimum.

NEW PATENTS OF THE INDUSTRY



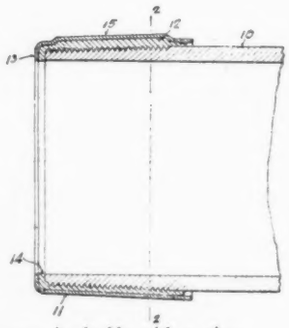
1,839,566. WELL SWAB. VANN MARS LIGON, Wichita Falls, Tex., assignor, by direct and mesne assignments, of two-thirds to Bert Lester Ligon, Wichita Falls, Tex., and one-third to C. W. Boller, Wichita Falls, Tex. Filed Apr. 29, 1929. Serial No. 358,822. 14 Claims. (Cl. 74—109.)

1. A swab including a mandrel, a supporting ring thereon, a flexible cup on said ring, a retaining plate on said mandrel to support the upper end of said cup, said cup having a longitudinal movement between said plate and said ring.

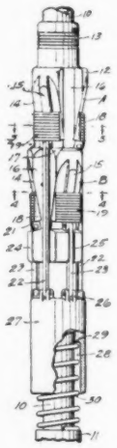
1,839,632. METHOD OF AND APPARATUS FOR TREATING OIL WELLS. WILLIAM W. AGNEW, Parkers Landing, Pa., assignor of sixty per cent to J. B. Davis, Dallas, Tex. Filed June 26, 1930. Serial No. 463,926. 3 Claims. (Cl. 219—33.)

1. A heating device for treating wells and the like, comprising a fluid tight casing having end portions of tapering form, to permit of convenient movement into and from pump tubing, one of said end portions being removable, an electrical conductor extending through the uppermost end portion, upper and lower conductor blocks in the casing, perforated insulating discs in the casing, resistor bars connected at their upper and lower ends, respectively, to said blocks and each extending through a perforation in each of said discs, a connection between the said conductor and one of the blocks, and an electrical conductor connected to the other block.

1,839,448. PIPE THREAD PROTECTOR. RICHARD STRESAU, Wauwatosa, Wis., assignor to A. O. Smith Corporation, Milwaukee, Wis., a Corporation of New York. Filed Nov. 3, 1927. Serial No. 230,717. 7 Claims. (Cl. 137—91.)

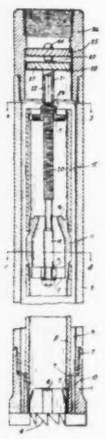


1. A pipe thread protector comprising a shell having relatively narrow longitudinally extending ribs upon its exterior and correspondingly grooved at its interior, and a soft metal cushioning liner therefor, the liner having an interlocking engagement upon its outside with the grooves of the ribs to maintain the liner in position in the shell, and adapted to have a threaded engagement upon its inside with a pipe.



1,839,652. TUBING CATCHER. FREDERICK N. CRIPPEN, Los Angeles, Calif., assignor to William R. Guiberson, Los Angeles, Calif. Filed Apr. 19, 1930. Serial No. 445,776. 13 claims. (Cl. 103—219.)

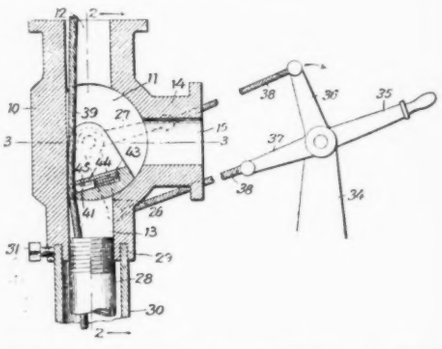
1. In a well tubing catcher, a support adapted to be connected to a string of tubing, a head mounted on same support and having inclined guide faces at different elevations, gripper slips mounted to slide on the faces of said head, whereby they are displaced radially thereof, and means for automatically displacing all of said slips in unison when the catcher is dropped.



1,839,417. TUBING OPERATED VALVE. FLOYD L. SCOTT, Houston, Tex., assignor to Hughes Tool Company, Houston, Tex., a Corporation of Texas. Filed July 23, 1927. Serial No. 208,001. 9 Claims. (Cl. 255—72.)

8. The combination of a core barrel, a valve seat at its upper end, a valve above said seat, and a screw rod operating said valve and adapted to move said valve slowly to its seat.

1,839,198. SAFETY VALVE FOR GAS OR OIL WELLS. FRANK CARROLL, Clairton, and WILBUR COSS, Wilson, Pa. Filed Sept. 16, 1929. Serial No. 393,042. 5 Claims. (Cl. 137—139.)



1. A device of the class described comprising a casing, aligned openings in said casing, a lateral opening at the side of the casing, a substantially yoke-shaped valve body pivotally mounted in said casing and movable to a position to close any one of said openings, a recess in one edge of the valve body for receiving a tool suspending cable, and a spring pressed plunger in said valve body normally closing said recess but yieldable to permit the cable to enter the recess.